OCS EIS/EA
BOEM 2020-025

Vineyard Wind 1 Offshore Wind Energy Project

Supplement to the Draft Environmental Impact Statement

June 2020

Estimated Lead Agency Costs Associated with Developing and Producing this Supplement to the Draft EIS: $1,877,000

U.S. Department of the Interior
Bureau of Ocean Energy Management
www.boem.gov

Documents related to the Vineyard Wind 1 Offshore Wind Energy Project can be found at https://www.boem.gov/vineyard-wind and include the following:

- 2020 Construction and Operations Plan
- 2019 Construction and Operations Plan Addendum
- Biological Assessment submitted to the U.S. Fish and Wildlife Service
- Biological Assessment submitted to NOAA Fisheries
- Cumulative Visual Assessment

In addition, direct links to various project documents are provided throughout this Supplement to the Draft Environmental Impact Statement. During your review of the document, your mouse will change to a hand icon, indicating the availability of a direct link.

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Author:

Bureau of Ocean Energy Management
Office of Renewable Energy Programs

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ENVIRONMENTAL IMPACT STATEMENT
FOR THE VINEYARD WIND 1 OFFSHORE WIND ENERGY PROJECT
DRAFT ( ) FINAL ( ) DRAFT SUPPLEMENTAL (X)

Lead Agency:	U.S. Department of the Interior, Bureau of Ocean Energy Management (BOEM), Office of Renewable Energy Programs
Cooperating Federal Agencies:	U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service U.S. Department of Defense, Army Corps of Engineers U.S. Department of Homeland Security, Coast Guard U.S. Department of the Interior, Bureau of Safety and Environmental Enforcement U.S. Environmental Protection Agency
Cooperating Tribal Nation:	Narragansett Indian Tribe
Cooperating State Agencies:	Massachusetts Office of Coastal Zone Management Rhode Island Coastal Resource Management Council Rhode Island Department of Environmental Management
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Area:	Lease Area OCS-A 0501
Date for Comments:	July 27, 2020

Abstract:

BOEM has supplemented the Vineyard Wind Draft Environmental Impact Statement (Draft EIS), released in December 2018, in consideration of the comments received during the National Environmental Policy Act (NEPA) process and in coordination with cooperating agencies. This supplement analyzes reasonably foreseeable effects from an expanded cumulative activities scenario for offshore wind development, previously unavailable fishing data, a new transit lane alternative, and changes to the proposed Vineyard Wind 1 Project (proposed Project) since publication of the Draft EIS. BOEM has supplemented the Draft EIS pursuant to the Council on Environmental Quality (CEQ) regulations for implementing NEPA for a Supplemental EIS (SEIS) (40 CFR 1502.9(c)). BOEM will incorporate the updated cumulative scenario and effects analysis from the SEIS into the Final EIS before publication, along with consideration of comments received during the SEIS comment period and comments received on the Draft EIS. The EIS will inform BOEM in deciding whether to approve, approve with modifications, or disapprove the proposed Project. Cooperating agencies will rely on the EIS to support their decision making as well if they determine the analysis is sufficient to support its decision. BOEM's action furthers U.S. policy to make the Outer Continental Shelf energy resources available for development in an expeditious and orderly manner, subject to environmental safeguards (43 USC § 1332(3)), including consideration of natural resources and existing ocean uses.

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EXECUTIVE SUMMARY

In consideration of the comments received during the National Environmental Policy Act (NEPA) process and in coordination with cooperating agencies, the Bureau of Ocean Energy Management (BOEM) has supplemented the Vineyard Wind Draft Environmental Impact Statement (Draft EIS) released in December 2018. This Supplemental Environmental Impact Statement (SEIS) analyzes reasonably foreseeable effects from an expanded cumulative activities scenario for offshore wind development, previously unavailable fishing data, a new transit lane alternative, and changes since publication of the Draft EIS to the proposed Vineyard Wind 1 Offshore Wind Energy Project (proposed Project). Vineyard Wind LLC's (Vineyard Wind) proposed Project would be southeast of Martha's Vineyard and about 800 megawatts (MWs) in scale. BOEM has supplemented the Draft EIS in accordance with the requirements of NEPA (42 United States Code [USC] §§ 4321–4370f) and the Council on Environmental Quality regulations for implementing NEPA for an SEIS (40 Code of Federal Regulations [CFR] 1502.9(c)). BOEM is providing 45 days following publication of this document for public review and comment (40 CFR § 1506.10(c) and 40 CFR § 1503.1(a)).

Following the comment period, BOEM will assess and consider all comments received from the Draft EIS public comment period as well as during the SEIS public comment period in the Final EIS. BOEM will also incorporate the updated cumulative scenario and effects analysis from the SEIS into the Final EIS. NEPA requires BOEM to wait a minimum of 30 days after the Final EIS is published before issuing a Record of Decision (ROD). The ROD will state whether BOEM intends to approve, approve with modifications, or disapprove the Vineyard Wind 1 Project Construction and Operations Plan (COP) for construction, operation, and eventual decommissioning of the proposed Project within Lease Area OCS-A 0501. In conjunction with the COP, Vineyard Wind submitted an application to the National Marine Fisheries Service (NMFS) for take of marine mammals incidental to the proposed Project construction. NMFS is required to review applications and, if appropriate, issue an Incidental Take Authorization (ITA) pursuant to the Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1361 et seq.). In addition, NMFS has an independent responsibility to comply with NEPA to consider the environmental effects of its proposal to issue an ITA to Vineyard Wind. Therefore, consistent with the requirements of Executive Order (EO) 13807[1] and 40 CFR §1506.3, NMFS intends to sign the ROD, and if appropriate, adopt BOEM's Final EIS[2]. The U.S. Army Corps of Engineers for their Clean Water Act Section 404/Rivers and Harbors Act of 1899 Section 10 Individual Permit would also adopt and sign the ROD in a similar manner. Cooperating agencies will rely on the ROD to support their decision-making.

ES1. PURPOSE AND NEED FOR THE PROPOSED ACTION

It is the policy of the United States to promote the clean and safe development of domestic energy resources, including renewable energy, to ensure the nation's geopolitical security and provide electricity that is affordable, reliable, safe, secure, and clean (EO 13783 of March 28, 2017). Through a competitive leasing process pursuant to 30 CFR § 585.211, Vineyard Wind was awarded Lease Area OCS-A 0501 offshore of Massachusetts and the exclusive right to submit a COP for activities within the lease area. Vineyard Wind has submitted a COP (Epsilon 2018a) proposing the construction, operation, maintenance, and conceptual decommissioning of a commercial-scale offshore wind energy facility within Lease Area OCS-A 0501. Vineyard Wind provided the most recent updates to this COP on March 9, 2020 (Epsilon 2020a). Vineyard Wind plans to begin construction in 2021.

The purpose of the federal agency action in response to the Vineyard Wind Project COP (Epsilon 2018a, 2019a, 2020a) is to determine whether to approve, approve with modifications, or disapprove the COP to construct, operate, and decommission an approximately 800-megawatt, commercial-scale wind energy facility within Lease Area OCS-A 0501 to meet New England's demand for renewable energy. More specifically, the proposed Project would deliver power to the New England energy grid to contribute to Massachusetts's renewable energy requirements—particularly, the commonwealth's mandate that distribution companies jointly and competitively solicit proposals for offshore wind energy generation (220 Code of Massachusetts Regulation [CMR] § 23.04(5)). BOEM's decision on Vineyard Wind's COP is needed to execute its duty to approve, approve with modifications, or disapprove the proposed Project in furtherance of the United States' policy to make Outer Continental Shelf (OCS) energy resources available for expeditious and orderly development, subject to environmental safeguards (43 USC § 1332(3)), including consideration of natural resources and existing ocean uses.

The minor changes in proposed Project specifications since the publication of the Draft EIS do not alter this purpose and need.

ES2. PUBLIC INVOLVEMENT

Prior to preparation of the Draft EIS, BOEM held five public scoping meetings near the proposed Project area to solicit feedback and identify issues and potential alternatives for consideration. The topics most referenced in the scoping comments include commercial fisheries and for-hire recreational fishing, Lewis Bay, the Project description, socioeconomics, and alternatives. On December 7, 2018, BOEM published a Notice of Availability (NOA) for the Draft EIS consistent with the regulations implementing NEPA (42 United States Code § 4321 et seq.) to assess the potential impacts of the Proposed Action and alternatives (Notice of Availability of a Draft Environmental Impact Statement for the Vineyard Wind LLC's Proposed Wind Energy Facility, 83 Fed. Reg. 63184 [December 8, 2018]). The NOA commenced the public review and comment period of the Draft EIS. BOEM held five public hearings (February 11–15, 2019) in the vicinity of the proposed Project area to solicit feedback and identify issues for consideration in updating the Final EIS. Throughout the public review and comment period, federal agencies; state, local, and tribal governments; and the general public had the opportunity to provide comments on the EIS. The topics most referenced during the Draft EIS comment period included commercial fisheries and for-hire recreational fishing, cumulative impacts, mitigation, finfish, invertebrates, and essential fish habitat,

[1] Under the One Federal Decision policy established by EO 13807, federal agencies with a role in the environmental review and permitting process for major infrastructure projects are required to prepare a single EIS and sign a single ROD.
[2] If NMFS determines the Final EIS is sufficient to support its decision under the Marine Mammal Protection Act.

and purpose and need. BOEM will hold public hearings during this period as specified in the NOA for this document (40 CFR § 1506.6(c)). Section 4.3 of the SEIS includes additional information on public involvement.

ES3. ENVIRONMENTAL AND CUMULATIVE IMPACTS

This SEIS reviews resource-specific baseline conditions and, using the methodology and assumptions outlined in Chapter 1 and Appendix A, assesses cumulative impacts that could result from the incremental impact of the Proposed Action and action alternatives when combined with past, present, or reasonably foreseeable activities, including other future offshore wind activities. To develop the cumulative activities scenario analyzed in this SEIS, BOEM conducted a thorough process to identify the possible extent of reasonably foreseeable offshore wind development on the Atlantic OCS. As a result of this process, BOEM has assumed that approximately 22 gigawatts of Atlantic offshore wind development are reasonably foreseeable along the east coast. Reasonably foreseeable development includes 17 active wind energy lease areas (16 commercial and 1 research). These include named projects and assumed future development within the remainder of lease areas outside of named project boundaries. Levels of assumed future development are based on state commitments to renewable energy development, available turbine technology, and the size of potential development areas. This scope for future offshore wind development is greatly expanded from what was considered in the Draft EIS, which only considered in detail projects that had submitted construction plans (approximately 130 MW) in federal waters at that time). The level of development expected to fulfill 22 gigawatts of offshore wind energy would result in the construction of about 2,000 wind turbines over a 10-year period on the Atlantic OCS, with currently available technology.

In addition, Appendix A specifies BOEM's assumptions related to the anticipated timing of reasonably foreseeable offshore wind activities, including the number of foundations anticipated in a given year over the next 6 to 10 years, some of which would overlap in time. The assumptions outlined are used in evaluating potential cumulative impacts on the resources analyzed in Chapter 3 and Appendix A.

Each resource has a geographic distribution and area in which effects of the proposed Project would be felt. Appendix A describes the geographic analysis area and provides figures depicting the geographic analysis area for each resource; identifies reasonably foreseeable offshore wind energy projects and other activities in addition to the proposed Project that are or could be located within the geographic areas depicted; and includes a cumulative impact scenario for each resource that is considered when analyzing impacts from these projects and activities collectively. These geographic boundaries remain largely unchanged from the Draft EIS. For boundaries that have changed from the Draft EIS, Table A-4 in Appendix A highlights the reasoning.

The 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 on irreversible or irretrievable commitments of resources resulting from implementation of a proposed action. Irreversible commitments occur when the primary or secondary impacts from the use of a resource either destroy the resource or preclude it from other uses. Irretrievable commitments occur when a resource is consumed to the extent that it cannot recover or be replaced.

Appendix D describes those potential unavoidable adverse impacts for the Proposed Action. Most potential unavoidable adverse impacts associated with the Proposed Action, such as disturbance of habitat or incremental disruption of typical daily activities, would occur during the construction phase, and would be temporary. Appendix D also describes irreversible and irretrievable commitment of resources by resource. The most notable such commitments could include effects on habitat or individual members of protected species, as well as potential loss of use of commercial fishing areas.

ES4. ALTERNATIVES

This SEIS evaluates six action alternatives (one of which has two sub-alternatives) and the No Action Alternative for the proposed Project (Section 2.1 includes additional information) as follows:

- Alternative A—Proposed Action
- Alternative B—Covell's Beach Cable Landfall Alternative
- Alternative C—No Surface Occupancy in the Northern-Most Portion of the Project Area Alternative
- Alternative D—Wind Turbine Layout Modification Alternative
  - Alternative D1—One-Nautical Mile Wind Turbine Spacing Alternative
  - Alternative D2—East-West and One-Nautical Mile Wind Turbine Layout Alternative[3]
- Alternative E—Reduced Project Size Alternative
- Alternative F—Vessel Transit Lane Alternative
- Alternative G—No Action Alternative

Alternatives B, C, D, E, and G are defined the same as in the Draft EIS Sections 2.1.2 through 2.1.6. This SEIS includes the addition of a Vessel Transit Lane Alternative, Alternative F.

In addition, changes have been made to the proposed Project since publication of the Draft EIS, and these changes are described in Section 2.2. To the extent they are applicable, the changes to the proposed Project (revised Project Design Envelope [PDE]) are also analyzed in the action alternatives assessed in this document, although the description of each individual alternative has not

[3] Small variances throughout a wind energy facility should not significantly affect safety of navigation. The 2020 draft Massachusetts and Rhode Island Port Access Route Study (MARIPARS; USCG 2020) provided quantitatively-derived recommendations for turbine spacing and transit lane widths within the wind arrays. For an array developed in a uniform grid, aligned along cardinal headings with 1 nautical mile spacing, the diagonal lanes would be approximately 0.7 nautical mile wide. The MARIPARS recommended that diagonal lanes be 0.6 to 0.8 nautical mile wide. Any movements in turbine location should not shrink the diagonal lanes to less than 0.6 nautical mile.

changed since the Draft EIS (Section 2.2). The summary of the Proposed Action (Alternative A) and the alternative analyses in this SEIS do not assume that the proposed mitigation measures discussed in the Draft EIS would be included to avoid or reduce potential impacts, but do include those measures Vineyard Wind has voluntarily committed to implement as part of the Proposed Action. Table E.S-1 details the changes to the limits of the PDE.

Table ES-1: Changes to the Limits of the PDE

Envelope Parameter	Previous Limit	Current Limit
Total Number of Turbines	Up to 100	57 to 100
Total Facility Capacity	~800 MW [a]	~800 MW [a]
Maximum Turbine Generation Capacity	10 MW	14 MW
Maximum Tip Height	696 feet (212 meters) MLLW [b]	837 feet (255 meters) MLLW [b]
Maximum Hub Height	397 feet (121 meters) MLLW [b]	473 feet (144 meters) MLLW [b]
Maximum Rotor Diameter	591 feet (180 meters) MLLW [b]	729 feet (222 meters) MLLW [b]
Maximum Tip Clearance	102 feet (31 meters) MLLW [b]	105 feet (32 meters) MLLW [b]
Substation Footprint	6.4 acres (25,899.9 m^2)	8.6 acres (34,803.1 m^2)

m^2 = square meters; MLLW = above mean lower low water; MW = megawatt

[a] Vineyard Wind's Proposed Action is for an 800-MW offshore wind energy project. This SEIS evaluates the potential impacts of a facility up to 800 MW to ensure that it covers projects constructed with a smaller capacity.

[b] Elevations relative to mean higher high water are approximately 3 feet (1 meter) lower than those relative to MLLW.

ES4.1. New Alternative F—Vessel Transit Lane Alternative

Since the Draft EIS was published, a new alternative has been added and analyzed in this Supplemental EIS.[4] Alternative F, Vessel Transit Lane Alternative, includes a new vessel transit lane in response to the January 3, 2020, Responsible Offshore Development Association (RODA) layout proposal (Figure 2.2-1) (RODA 2020). The RODA proposal includes designated transit lanes, each at least 4-nautical miles wide (Figure 2.2-2). Although the proposal includes six total transit lanes, only one intersects the Vineyard Wind 1 Project Wind Development Area, as shown in Figure 2.2-1, the action for which this EIS is being prepared. The purpose of the proposed northwest/southeast transit corridor would be mainly to facilitate vessel transit from southern New England ports—primarily New Bedford—to fishing areas on Georges Bank.

The WTGs that would have been located within the transit lane proposed to intersect the Wind Development Area would not be eliminated from the Proposed Action; but instead, the displaced WTGs would be shifted south within the Vineyard Wind lease area. Therefore, the number of placement locations would remain the same as assumed under the Proposed Action. This is the same approach that is utilized for Alternatives D1 and D2.

ES4.2. Comparison of Impacts by Action Alternative

Table ES-2 provides a summary and comparison of the direct, indirect, and cumulative impacts under each action alternative assessed in Chapter 3 and Appendix A. The impact analysis of resources with an overall minor impact level (green) are located in Appendix A. Tables 3-1 and 3-2 in Appendix B provide definitions for **negligible**, **minor**, **moderate**, and **major** impacts. 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 to the table. Although the detailed description of potential impacts could vary across action alternatives, as described in Chapter 3 and Appendix A, many of the differences in potential impacts across alternatives do not warrant differences in the impact ratings determined based on the definitions used.

Under Alternative G (No Action), any potential environmental and socioeconomic impacts, including benefits, associated with the proposed Project would not occur; however, impacts could occur from other activities as described in Section 3.1.

As summarized in Table ES-2 and assessed in detail in Chapter 3 of the SEIS, BOEM determined that the Proposed Action or certain action alternatives could have **major** direct or cumulative impacts on environmental justice communities, commercial fisheries, navigation, and other uses. The following **major** impacts are anticipated:

- **Major** direct impacts on environmental justice communities could occur from the Proposed Action and Alternatives C, D1, D2, and E due to the new cable emplacement/maintenance impact-producing factor (IPF) associated with the New Hampshire Avenue landfall site.
- **Major** direct impacts on navigation could occur as a result of the Proposed Action and Alternatives B, C, D1, E, and F (combined with the Proposed Action layout) due to the presence of structures IPF.
- **Major** cumulative effects could occur on commercial fisheries for the Proposed Action and all action alternatives due to the presence of structures IPF when combined with ongoing and future impacts as a result of climate change and reduced stock levels as a result of fishing mortality.
- **Major** cumulative impacts on scientific research and surveys (analyzed in the other uses section of the SEIS) could occur as a result of the Proposed Action and all action alternatives due to the presence of structures IPF. In addition, there would be **major** cumulative impacts on military and national security uses as a result of the Proposed Action and Alternatives B, C, D1, E, and F (combined with the Proposed Action layout) due to navigation complexity and the increased difficulty to conduct search and rescue.

[4] This new alternative describes "transit lanes" as requested by the Responsible Offshore Development Association (RODA). BOEM has no legal authority to require vessels to transit particular lanes through the proposed Project, although BOEM can manage the placement of structures attached to the seabed. That noted, this document will use the term "transit lane" throughout in discussion concerning Alternative F.

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Table ES-2: Impacts by Action Alternative Resource Affected

Resources	Proposed Action	Alternative B	Alternative C	Alternative D1	Alternative D2	Alternative E	Alternative F
Terrestrial and Coastal Fauna: *Direct and Indirect Impacts*	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate
Terrestrial and Coastal Fauna: *Cumulative Impacts*	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Coastal Habitats: *Direct and Indirect Impacts*	Net negligible, moderate including minor beneficial	Net negligible, moderate including minor beneficial	Net negligible, moderate including minor beneficial	Net negligible, moderate including minor beneficial	Net negligible, moderate including minor beneficial	Net negligible, moderate including minor beneficial	Net negligible, moderate including minor beneficial
Coastal Habitats: *Cumulative Impacts*	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Benthic Resources: *Direct and Indirect Impacts*	Negligible to moderate and moderate beneficial	Negligible to moderate and moderate beneficial	Negligible to moderate and moderate beneficial	Negligible to moderate and moderate beneficial	Negligible to moderate and moderate beneficial	Negligible to moderate and moderate beneficial	Negligible to moderate and moderate beneficial
Benthic Resources: *Cumulative Impacts*	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Finfish, Invertebrates, and Essential Fish Habitat: *Direct and Indirect Impacts*	Negligible to moderate and moderate beneficial	Negligible to moderate and moderate beneficial	Negligible to moderate and moderate beneficial	Negligible to moderate and moderate beneficial	Negligible to moderate and moderate beneficial	Negligible to moderate and moderate beneficial	Negligible to moderate and moderate beneficial
Finfish, Invertebrates, and Essential Fish Habitat: *Cumulative Impacts*	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Marine Mammals: *Direct and Indirect Impacts*	Negligible to moderate and potentially minor beneficial	Negligible to moderate and potentially minor beneficial	Negligible to moderate and potentially minor beneficial	Negligible to moderate and potentially minor beneficial	Negligible to moderate and potentially minor beneficial	Negligible to moderate and potentially minor beneficial	Negligible to moderate and potentially minor beneficial
Marine Mammals: *Cumulative Impacts*	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Sea Turtles: *Direct and Indirect Impacts*	Negligible to moderate and potentially minor beneficial	Negligible to moderate and potentially minor beneficial	Negligible to moderate and potentially minor beneficial	Negligible to moderate and potentially minor beneficial	Negligible to moderate and potentially minor beneficial	Negligible to moderate and potentially minor beneficial	Negligible to moderate and potentially minor beneficial
Sea Turtles: *Cumulative Impacts*	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Demographics, Employment, and Economics: *Direct and Indirect Impacts*	Negligible to moderate and negligible to minor beneficial	Negligible to moderate and negligible to minor beneficial	Negligible to moderate and negligible to minor beneficial	Negligible to moderate and negligible to minor beneficial	Negligible to moderate and negligible to minor beneficial	Minor to moderate and negligible to minor beneficial	Negligible to moderate and negligible to minor beneficial
Demographics, Employment, and Economics: *Cumulative Impacts*	Minor and minor beneficial	Minor and minor beneficial	Minor and minor beneficial	Minor and minor beneficial	Minor and minor beneficial	Minor and minor beneficial	Minor and minor beneficial
Environmental Justice: *Direct and Indirect Impacts*	Negligible to major, depending on the specific community affected, and beneficial	Negligible to moderate, depending on the specific community affected, and beneficial	Negligible to major, depending on the specific community affected, and beneficial	Negligible to major, depending on the specific community affected, and beneficial	Negligible to major, depending on the specific community affected, and beneficial	Negligible to major, depending on the specific community affected, and beneficial	Negligible to moderate, depending on the specific community affected, and beneficial
Environmental Justice: *Cumulative Impacts*	Minor	Minor	Minor	Minor	Minor	Minor	Minor
Cultural, Historical, and Archaeological Resources: *Direct and Indirect Impacts*	Negligible to moderate, depending on the specific resource affected	Negligible to moderate, depending on the specific resource affected	Negligible to moderate, depending on the specific resource affected	Negligible to moderate, depending on the specific resource affected	Negligible to moderate, depending on the specific resource affected	Minor to moderate, depending on the specific resource affected	Negligible to moderate, depending on the specific resource affected
Cultural, Historical, and Archaeological Resources: *Cumulative Impacts*	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Recreation and Tourism: *Direct and Indirect Impacts*	Negligible to moderate and negligible to minor beneficial	Negligible to moderate and negligible to minor beneficial	Negligible to moderate and negligible to minor beneficial	Negligible to moderate and negligible to minor beneficial	Negligible to moderate and negligible to minor beneficial	Negligible to moderate and negligible to minor beneficial	Negligible to moderate and negligible to minor beneficial
Recreation and Tourism: *Cumulative Impacts*	Moderate and minor beneficial	Moderate and minor beneficial	Moderate and minor beneficial	Moderate and minor beneficial	Moderate and minor beneficial	Moderate and minor beneficial	Moderate and minor beneficial
Commercial Fisheries and For-Hire Recreational Fishing: *Direct and Indirect Impacts*	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Commercial Fisheries and For-Hire Recreational Fishing: *Cumulative Impacts*	Major	Major	Major	Major	Major	Major	Major
Land Use and Coastal Infrastructure: *Direct and Indirect Impacts*	Negligible to moderate and negligible to minor beneficial	Negligible to minor and negligible to minor beneficial	Negligible to moderate and negligible to minor beneficial	Negligible to moderate and negligible to minor beneficial	Negligible to moderate and negligible to minor beneficial	Negligible to moderate and negligible to minor beneficial	Negligible to moderate and negligible to minor beneficial
Land Use and Coastal Infrastructure: *Cumulative Impacts*	Minor and minor beneficial	Minor and minor beneficial	Minor and minor beneficial	Minor and minor beneficial	Minor and minor beneficial	Minor and minor beneficial	Minor and minor beneficial
Navigation and Vessel Traffic: *Direct and Indirect Impacts*	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate
Navigation and Vessel Traffic: *Cumulative Impacts*	Major	Major	Major	Major	Moderate	Major	Moderate to Major
Other Uses: Direct and *Indirect Impacts*	Major for scientific research and surveys, minor to moderate for military and national security uses and negligible to minor for aviation and air traffic, cables and pipelines, and radar systems	Major for scientific research and surveys, minor to moderate for military and national security uses and negligible to minor impacts for aviation and air traffic, cables and pipelines, and radar systems	Major impacts on scientific research and surveys, minor to moderate for military and national security uses and negligible to minor impacts for aviation and air traffic, cables and pipelines, and radar systems	Major impacts on scientific research and surveys, minor to moderate for military and national security uses and negligible to minor impacts for aviation and air traffic, cables and pipelines, and radar systems	Major impacts on scientific research and surveys, minor to moderate for military and national security uses and negligible to minor impacts for aviation and air traffic, cables and pipelines, and radar systems	Major impacts on scientific research and surveys, minor to moderate for military and national security uses and negligible to minor impacts for aviation and air traffic, cables and pipelines, and radar systems	Major impacts on scientific research and surveys, minor to moderate for military and national security uses and negligible to minor impacts for aviation and air traffic, cables and pipelines, and radar systems
Other Uses: *Cumulative Impacts*	Major for military and national security uses and scientific research and surveys and negligible to minor for aviation and air traffic, cable and pipelines, and radar systems	Major for military and national security uses and scientific research and surveys and negligible to minor for aviation and air traffic, cable and pipelines, and radar systems	Major for military and national security uses and scientific research and surveys and negligible to minor for aviation and air traffic, cable and pipelines, and radar systems	Major for military and national security uses and scientific research and surveys and negligible to minor for aviation and air traffic, cable and pipelines, and radar systems	Major for scientific research and surveys, moderate for military and national security uses and negligible to minor for aviation and air traffic, cable and pipelines, and radar systems	Major for military and national security uses and scientific research and surveys and negligible to minor for aviation and air traffic, cable and pipelines, and radar systems	Major for scientific research and surveys, moderate to major for military and national security uses and negligible to minor for aviation and air traffic, cable and pipelines, and radar systems
Air Quality: *Direct and Indirect Impacts*	Negligible to minor and minor beneficial	Negligible to minor and minor beneficial	Negligible to minor and minor beneficial	Negligible to minor and minor beneficial	Negligible to minor and minor beneficial	Negligible to minor and minor beneficial	Negligible to minor and minor beneficial
Air Quality: *Cumulative Impacts*	Minor	Minor	Minor	Minor	Minor	Minor	Minor
Water Quality: *Direct and Indirect Impacts*	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor
Water Quality: *Cumulative Impacts*	Minor	Minor	Minor	Minor	Minor	Minor	Minor
Birds: *Direct and Indirect Impacts*	Negligible to minor and potentially minor beneficial	Negligible to minor and potentially minor beneficial	Negligible to minor and potentially minor beneficial	Negligible to minor and potentially minor beneficial	Negligible to minor and potentially minor beneficial	Negligible to minor and potentially minor beneficial	Negligible to minor and potentially minor beneficial
Birds: *Cumulative Impacts*	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Bats: *Direct and Indirect Impacts*	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor
Bats: *Cumulative Impacts*	Minor	Minor	Minor	Minor	Minor	Minor	Minor

Impact rating colors are as follows: orange = major; yellow = moderate; green = minor; light green = negligible or beneficial to any degree. All impact levels are assumed to be adverse unless otherwise specified as beneficial. Where impacts are presented as multiple levels, the color representing the most adverse level of impact has been applied.
The details of particular impacts and explanations for ranges of impact levels are found in each resource section.

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ABBREVIATIONS AND ACRONYMS

Acronym	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
µPa	micropascal
µPa2s	micropascal squared second
µT	microtesla
ADLS	Aircraft Detection Light System
AWEA	American Wind Energy Association
AWOIS	Automated Wreck and Obstruction Information System
B.P.	before present
BA	Biological Assessment
BMP	best management practice
BOEM	Bureau of Ocean Energy Management
BSW	Bay State Wind
Btu	British thermal unit
Call	Call for Information and Nominations
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMR	Code of Massachusetts Regulation
CO	carbon monoxide
CO_2	carbon dioxide
COP	Construction and Operations Plan
CVOW	Coastal Virginia Offshore Wind
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
D	distance proportional to the pile diameter
Deepwater WLA	Deepwater Wind Lease Area
dB	decibel
dB re 1µPa	decibels relative to one micropascal
dB RMS	decibels root mean squared
DOE	U.S. Department of Energy
DP	dynamic positioning
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EMF	electromagnetic field
ENC	Electronic Navigational Chart
EO	Executive Order
ESA	Endangered Species Act
ESP	electrical service platform
FAA	Federal Aviation Administration
FAD	fish aggregating devices
FCC	Federal Communications Commission
Fed. Reg.	Federal Register
FMP	Fisheries Management Plan

Acronym	Definition
FTE	full time equivalent
G&G	Geological and Geophysical
GDP	gross domestic product
GHG	greenhouse gas
GW	gigawatts
HAPC	Habitat Area of Particular Concern
hazmat	hazardous materials
HMS	Highly Migratory Species
HRG	High Resolution Geophysical
Hz	hertz
IHA	Incidental Harassment Authorization
IPaC	Information for Planning and Consultation
IPF	impact-producing factors
ITA	Incidental Take Authorization
km^2	square kilometers
LE_{24}	cumulative sound exposure over 24 hours
LME	Large Marine Ecosystem
m^2	square meters
MA Lease Area	Massachusetts Lease Area
MARIPARS	Massachusetts and Rhode Island Port Access Route Study
Mass CEC	Massachusetts Clean Energy Center
MCT	New Bedford Marine Commerce Terminal
met	meteorological
mg/L	milligrams per liter
MLLW	above mean lower low water
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MW	megawatt
MW/nm^2	megawatt per square nautical mile
NA	not applicable
NARW	North Atlantic right whale
Navy	United States Navy
NEFSC	New England Fishery Science Center
NEPA	National Environmental Policy Act
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
nm^2	square nautical miles
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOx	nitrogen oxides

Acronym	Definition
NRA	Navigational Risk Assessment
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
OCS	Outer Continental Shelf
OECC	Offshore Export Cable Corridor(s)
OECR	Onshore Export Cable Route
OREC	Offshore Wind Renewable Energy Credit
OWF	offshore wind farms
PAM	passive acoustic monitoring
PDE	Project Design Envelope
$PM_{2.5}$	particulate matter with diameters 2.5 microns and smaller
PM_{10}	particulate matter with diameters 10 microns and smaller
PPA	Power Purchase Agreement
PPW	pinnipeds in the water
ProvPort	Port of Providence
Project	Vineyard Wind 1 Offshore Wind Energy Project
PSO	protected species observer
PTS	permanent threshold shift
RI and MA Lease Areas	Rhode Island and Massachusetts Lease Areas
ROD	Record of Decision
RODA	Responsible Offshore Development Alliance
ROW	right-of-way
SAP	Site Assessment Plan
SAR	search and rescue
SEIS	Supplemental EIS

Acronym	Definition
SO2	sulfur dioxide
SOV	service operations vessel
SPL	sound pressure level
STSSN	Sea Turtle Stranding and Salvage Network
SSU	special, sensitive, and unique
TCP	Traditional Cultural Property
THPO	Tribal Historic Preservation Officer
TSS	total suspended solids
TTS	temporary threshold shift
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
Vineyard Wind	Vineyard Wind LLC
VOC	volatile organic compound
VMS	Vessel Monitoring System
VTR	Vessel Trip Report
WDA	Wind Development Area
WEA	Wind Energy Area
WMA	Wildlife Management Area
WTG	wind turbine generator

1. INTRODUCTION

The Bureau of Ocean Energy Management (BOEM) has supplemented the Vineyard Wind Draft Environmental Impact Statement (EIS) released in December 2018, in consideration of the comments received during the National Environmental Policy Act (NEPA) process and in coordination with cooperating agencies.[1] This Supplemental Environmental Impact Statement (SEIS) analyzes reasonably foreseeable effects from an expanded cumulative activities scenario for offshore wind development, previously unavailable fishing data, a new transit lane alternative, and changes since publication of the Draft EIS to Vineyard Wind LLC's (Vineyard Wind's) proposed Vineyard Wind 1 Offshore Wind Energy Project (proposed Project) southeast of Martha's Vineyard and about 800 megawatts (MW) in scale. BOEM has supplemented the Draft EIS in accordance with the requirements of NEPA (42 United States Code [USC] §§ 4321–4370f) and the Council on Environmental Quality (CEQ) regulations for implementing NEPA for an SEIS (40 Code of Federal Regulations [CFR] 1502.9(c)). BOEM is providing 45 days following publication of this document for public review and comment (40 CFR § 1506.10(c) and 40 CFR § 1503.1(a)). BOEM anticipates holding public hearings during this period as specified in the Notice of Availability for this document (40 CFR § 1506.6(c)).[2] Following the comment period, BOEM will assess and consider all comments received from the Draft EIS public comment period as well as during the SEIS public comment period in the Final EIS. BOEM will incorporate the updated cumulative scenario and effects analysis from the SEIS into the Final EIS.NEPA requires BOEM to wait a minimum of 30 days after the Final EIS is published before issuing a Record of Decision (ROD). The ROD will state whether BOEM intends to approve, approve with modifications, or disapprove the Vineyard Wind 1 Project Construction and Operations Plan (COP) for construction, operation, and eventual decommissioning of the proposed Project within Lease Area OCS-A 0501.[3] Cooperating agencies will rely on the ROD to support their decision-making. In conjunction with the COP, Vineyard Wind submitted an application to the National Marine Fisheries Service (NMFS) for take of marine mammals incidental to the proposed Project construction. NMFS is required to review applications and, if appropriate, issue an Incidental Take Authorization (ITA) pursuant to the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 U.S.C. 1361 et seq.). In addition, NMFS has an independent responsibility to comply with NEPA to consider the environmental effects of its proposal to issue an ITA to Vineyard Wind. Therefore, consistent with the requirements of Executive Order 13807[4] and 40 CFR §1506.3, NMFS intends to sign the ROD, and if appropriate, adopt BOEM's Final EIS[5]. The U.S. Army Corps of Engineers (USACE) for their Clean Water Act Section 404/Rivers and Harbors Act of 1899 Section 10 Individual Permit would also adopt and sign the ROD in a similar manner.

The remainder of this chapter introduces the proposed Project, the process used to assess its potential environmental, social, economic, historic, and cultural impacts, and the subsequent decision-making process. A detailed description of the proposed Project can be found in Chapter 1 of the 2018 Draft EIS. Chapter 2 of this SEIS describes changes to the proposed Project since the publication of the Draft EIS. This SEIS focuses on the potential cumulative environmental, social, economic, historic, and cultural impacts that could result from the construction, operation, maintenance, and future decommissioning of the proposed Project, when combined with other past, present, or reasonably foreseeable actions or projects.[6]

1.1. Purpose and Need

It is the policy of the United States to promote the clean and safe development of domestic energy resources, including renewable energy, to ensure the nation's geopolitical security and provide electricity that is affordable, reliable, safe, secure, and clean (Executive Order [EO] 13783 of March 28, 2017). Through a competitive leasing process pursuant to 30 CFR § 585.211, Vineyard Wind was awarded Lease Area OCS-A 0501 offshore of Massachusetts and the exclusive right to submit a COP for activities within the lease area.[7] Vineyard Wind has submitted a COP (Epsilon 2018a) proposing the construction, operation, maintenance, and conceptual decommissioning of a commercial-scale offshore wind energy facility within Lease Area OCS-A 0501. Vineyard Wind provided the most recent updates to this COP on March 9, 2020 (Epsilon 2020a). Vineyard Wind plans to begin construction in 2021.

The purpose of the federal agency action in response to the Vineyard Wind Project COP (Epsilon 2018a, 2019a, 2020a) is to determine whether to approve, approve with modifications, or disapprove the COP to construct, operate, and decommission an approximately 800-MW, commercial-scale wind energy facility within Lease Area OCS-A 0501 to meet New England's demand for renewable energy. More specifically, the proposed Project would deliver power to the New England energy grid to contribute to Massachusetts's renewable energy requirements—particularly, the commonwealth's mandate that distribution companies jointly and competitively solicit proposals for offshore wind energy generation (220 Code of Massachusetts Regulation [CMR] § 23.04(5)). BOEM's decision on Vineyard Wind's COP is needed to execute its duty to approve, approve with modifications, or disapprove the proposed Project in furtherance of the United States' policy to make Outer Continental Shelf (OCS) energy resources available for expeditious and orderly development, subject to environmental safeguards (43 USC § 1332(3)), including consideration of natural resources and existing ocean uses.

[1] https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/MA/Vineyard-Wind/Vineyard_Wind_Draft_EIS.pdf

[2] See http://www.regulations.gov, docket number BOEM-2020-0005.

[3] As described in Chapter 1 of the 2018 Draft EIS, the COP characterizes the proposed Project as occurring in the northern portion of Lease Area OCS-A-0501. This northern portion is referred to as the Wind Development Area (WDA) amounting to 75,614 acres (306 km^2) of the 166,886 acre (675 km^2) lease area.

[4] Under the One Federal Decision policy established by Executive Order (EO) 13807, Federal agencies with a role in the environmental review and permitting process for major infrastructure projects are required to prepare a single EIS and sign a single ROD.

[5] If NMFS determines the Final EIS is sufficient to support its decision under the MMPA.

[6] For analysis purposes, BOEM assumes in this SEIS that the proposed Project would have an operating period of 30 years. Vineyard Wind's lease with BOEM (Lease OCS-A 0501) has an operations period of 25 years that commences on the date of COP approval. (See https://www.boem.gov/Lease-OCS-A-0501/ at Addendum B; see also 30 CFR § 585.235(a)(3).) Vineyard Wind would need to request an extension of its operations period from BOEM in order to operate the proposed Project for 30 years. For purposes of the maximum-case scenario and to ensure NEPA coverage if BOEM grants such an extension, however, the SEIS analyzes a 30-year operations period.

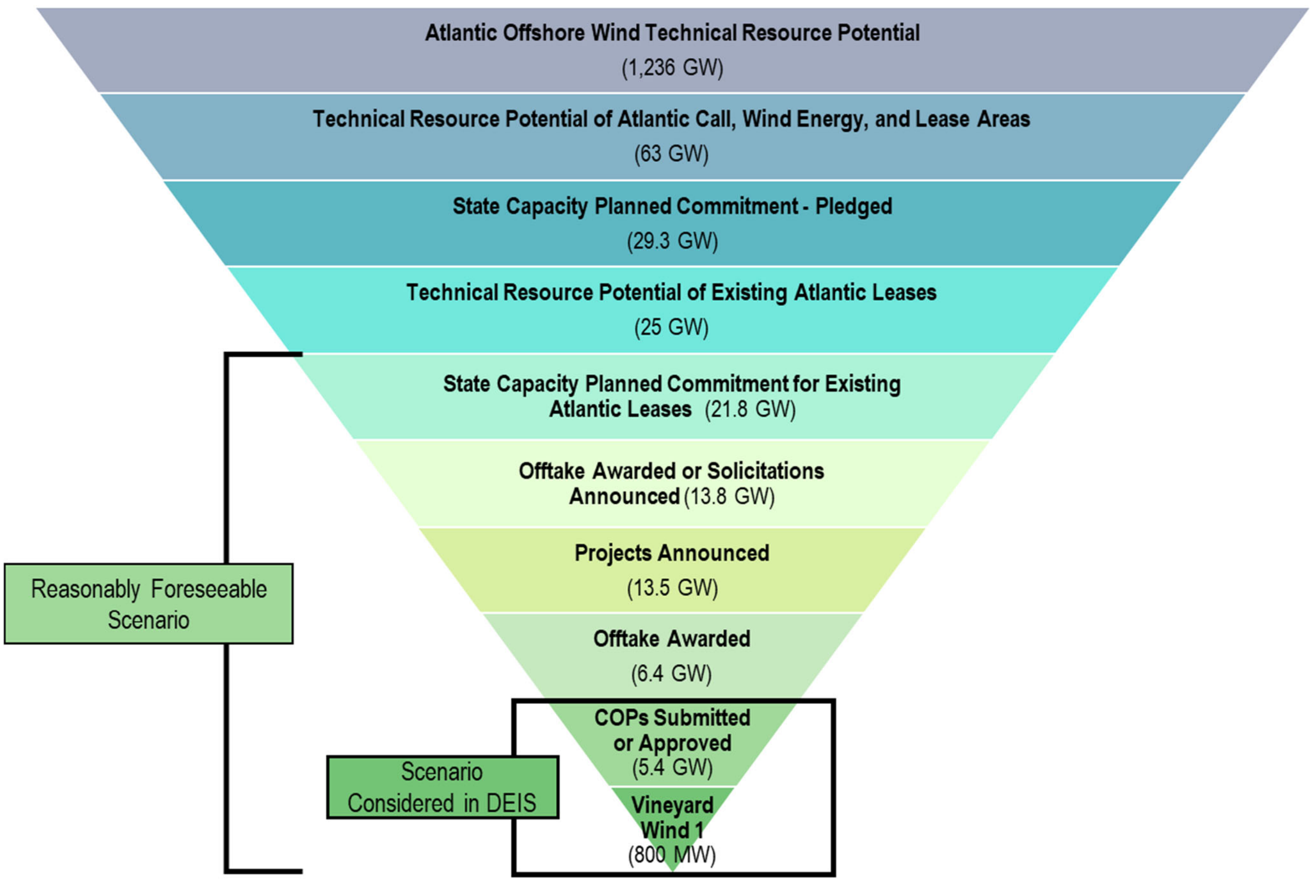
[7] Lessees may request to assign a portion of their lease to another qualified legal entity. For additional information on this please see Appendix A.

The minor changes in proposed Project specifications since the publication of the Draft EIS do not alter this purpose and need.

1.2. METHODOLOGY FOR ASSESSING CUMULATIVE IMPACTS

1.2.1. Overview of the Cumulative Scope for Offshore Wind Activities

BOEM thoroughly analyzed the possible extent of future offshore wind development in the United States on the Atlantic OCS to determine reasonably foreseeable cumulative effects measured by installed power capacity. This is summarized in Figure 1.2-1, and expands what offshore wind actions are considered reasonably foreseeable beyond those included in the Draft EIS to include approximately 22 gigawatts (GW) of offshore wind power projects.



Note: Each category or level includes the entirety of the levels below it. Further, these categories are not mutually exclusive and some of them include projects that fall under other categories (e.g., the Technical Resource Potential of Existing Atlantic Leases also includes the Vineyard Project).

Figure 1.2-1. Scope for Future Possible Development of Offshore Wind

The quantitative cumulative impact analysis in the Draft EIS only considered as reasonably foreseeable those proposed offshore wind projects with COPs submitted or approved at the time of analysis. Including the Proposed Action, this consisted of the Tier 1 and Tier 2 projects described in Appendix C of the Draft EIS totaling 926 MW. All other offshore wind projects were not considered reasonably foreseeable in the Draft EIS; however, the cumulative impacts of Tier 3 projects were incorporated into the Draft EIS based on information available. BOEM considers the scope of the analysis in the Draft EIS to be NEPA-compliant. Considering that wind energy is a growing industry, BOEM decided to expand its cumulative impact analysis and has concluded that approximately 22 GW[8] of Atlantic offshore wind development is reasonably foreseeable, encompassing the following potential development:

- Vineyard Wind 1 (proposed Project, 800 MW);
- All projects with COPs approved or submitted (in addition to the proposed Project), which includes South Fork Wind, Bay State Wind, Skipjack Wind, Ocean Wind, Coastal Virginia Offshore Wind (CVOW), and Empire Wind) (5.4 GW);

[8] The existing lease areas are sufficient to support development of 22 GW of offshore wind.

- All projects with power offtake[9] awarded (with the exception of Bay State Wind[10]), which includes all of the projects listed in the previous criteria as well as Revolution Wind, U.S. Wind, Sunrise Wind, Mayflower Wind, and Vineyard Wind 2 [includes Park City Wind]) (6.4 GW);
- All projects for which the developer has publicly announced development plans, regardless of whether a COP has been approved or submitted or offtake awarded (in addition to the projects identified in the previous criteria), which includes Liberty Wind and Dominion Energy (13.5 GW);
- All announced and scheduled state offtake solicitations, whether or not they are linked to plans or arrangements with particular developers. With the exception of Dominion Energy, this includes all of the projects identified in the previous criterion, as well as the additional development necessary to fulfill the remaining announced offshore wind solicitations (distinct from announced state goals, 2,534 MW[11] beyond what is currently represented by submitted or announced COPs). The development considered here is geographically sensitive and assumes that state interest levels do not shift (13.8 GW).
- The remaining planned but unscheduled Atlantic state solicitations for existing lease areas (Massachusetts and Virginia) (22 GW).[12] There are no submitted COPs for some of the actions considered reasonably foreseeable in this scenario. However, this information is not essential to a reasoned choice among alternatives.

1.2.1.1. Reasonably Foreseeable Assumptions

- It is difficult to predict turbine capacity and spacing or other future engineering for planned but currently unscheduled offshore wind awards. For those projects with announced WTG sizes, BOEM assumed an 8 or 12 MW WTG. BOEM understands that turbine capacity may exceed 12 MW in the future. However, for future procurements and projects under this cumulative analysis, BOEM evaluates potential impacts assuming that 12-MW WTGs will be used—since it is the largest turbine now commercially available (Appendix A).
- The simultaneous construction of multiple projects within the U.S. Atlantic region would require a substantial number of specialized vessels and a robust supply chain. BOEM's analysis to develop a reasonably foreseeable build-out scenario assumes the challenges of vessel availability and supply chain will be overcome and projects will advance at the schedule the states and developers have announced.
- BOEM assumes that all planned offshore wind procurements will be awarded, even for those states that have clauses requiring state boards or commissions to only approve offshore wind procurements if determined in the public interest or in the best interest of ratepayers. If any offshore wind agreements are not awarded, fewer projects will be developed than BOEM foresees.
- Some states might include technical, economic, or environmental stipulations in their offshore wind solicitations that are too burdensome for prospective developers, and this would reduce BOEM's build-out scenario.
- Infrastructure does not currently exist to handle interconnection points and transmission for 22 GW of Atlantic offshore wind energy. BOEM assumes these challenges will be solved and that 22 GW of Atlantic offshore wind can be built. This analysis does not address potential solutions, but independent transmission proposals dedicated to offshore wind energy could assist.
- BOEM assumes that each project would have its own submarine transmission line and that regional transmission right-of-way projects are not currently foreseeable. However, if shared submarine cable were developed in the future, environmental impacts would be reduced for most resources.
- Appendix A details BOEM's technical assumptions regarding the design and placements of potential future project elements (e.g., WTGs, cables). This appendix also specifies BOEM's assumptions related to the anticipated timing of reasonably foreseeable offshore wind activities, including the number of foundations anticipated in a given year over the next 6 to 10 years, some of which would overlap in time. The assumptions outlined are used in evaluating potential cumulative impacts on the resources analyzed in this document.

1.2.1.2. Detailed Cumulative Scope for Offshore Wind Activities

Before deciding on the cumulative scope described in Section 1.2.1.1, BOEM evaluated several possible options. Each bar in Figure 1.2-1 represents possible offshore wind development based on the factors necessary for project development to occur (resource potential, area available, demand, and level of planning). From the top of the figure, moving down, each bar narrows the level of potential development when compared to the bars above it. Each bar also represents a level of specific information available regarding the potential development, with increasing information as one goes down the inverted pyramid. To capture this information, BOEM began by reviewing the U.S. Department of Energy's (DOE) 2016 Offshore Wind Energy Resource Assessment for the United States (Musial et al. 2016) and the DOE's 2018 *Offshore Wind Technologies Market Report* (DOE 2019). Next, BOEM estimated the capacity of existing planning and lease areas, and reviewed state legislation, offshore wind commitments, and requests for proposals. BOEM also reached out to states when information was unclear or lacking, and compiled current and potential projects from submitted plans, discussions with lessees, and industry announcements.

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[9] Offtake in this document is defined as the offshore wind energy produced and delivered to shore for use by purchasers.

[10] Bay State Wind submitted a COP, but currently has no offtake awarded for the project.

[11] A total of 7,308 MW of procurements have been announced and 4,240 MW of available capacity identified in submitted or announced COPs. Some states have goals beyond announced procurements. The ability for a project to fulfill a particular procurement is geographically sensitive. Maryland and New Jersey each have announced procurements for which there are currently no nearby announced or submitted COPs with available capacity, though leased areas without an associated COP are available. Should New York announce additional procurements towards its state goal, both New York and New Jersey will have more announced procurements than available lease capacity within the New York Bight.

[12] Approximately 4.7 GW of planned solicitations for the state of New York are not included because BOEM considers them reliant on additional leasing in the New York Bight. Approximately 4 GW of offshore wind goals for the state of New Jersey are not included as BOEM considers them reliant on additional leasing in the New York Bight.

1.2.1.2.1. *Atlantic Offshore Wind Technical Resource Potential*

DOE estimates the technical resource potential of state and federal waters offshore Maine to Georgia (water depths less than 3,280 feet [1,000 meters]) to be 1,236 GW (top bar on Figure 1.2-1), about the same as the nation's current total electricity use. BOEM did not assume that offshore wind turbines would occupy every square mile of these areas or that more energy would be produced than could be procured by Atlantic states (Musial et al. 2016) because it considers such scenarios unfeasible. Instead, BOEM's cumulative analysis bases its estimate of wind technical resource potential on the potential of areas that are leased, excluding leased areas offshore North Carolina, which currently has no announced goals or stated demand for offshore wind energy.

1.2.1.2.2. *Technical Resource Potential of Atlantic Call, Wind Energy, and Lease Areas*

To determine developer interest in proposed areas, BOEM issues a Call for Information and Nominations (Call). BOEM's Call Areas are typically reduced through the planning and leasing processes following engagement with stakeholders, tribes, and state and federal government agencies. There are currently two Call Areas on the Atlantic OCS: New York (approximately 1,735,154 acres [7,022 square kilometers (km^2)]) and South Carolina (approximately 853,957 acres [3,456 km^2]). See second bar on Figure 1.2-1.

Call Areas are then narrowed into Wind Energy Areas (WEAs), which are areas that appear to be most suitable for commercial wind energy development while presenting the fewest apparent environmental and user conflicts. BOEM does not consider development of Call Areas and WEAs reasonably foreseeable because leasing of these areas is highly uncertain. BOEM could decide not to offer a WEA for leasing, and there is no guarantee that all areas offered for lease will receive bids.

1.2.1.2.3. *Technical Resource Potential of Existing Atlantic Leases*

There are currently 17 active wind energy lease areas (16 commercial and 1 research) covering approximately 1,744,289 acres (7,059 km^2). For this analysis, BOEM calculated their total technical capacity to be about 25 GW (Figure 1.2-1, fourth bar).[13] This is greater than the capacity previously stated by BOEM and estimated by the National Renewable Energy Laboratory (NREL).[14] It would represent greater offtake than is presently planned by Atlantic states. Unsuitable geological conditions identified during site characterization surveys, potential use conflicts, habitat resource concerns, endangered species effects, and future navigation corridors identified by the U.S. Coast Guard (USCG) could exclude significant portions of the leases from development. Therefore, it is improbable that Atlantic active leases will be developed to their maximum technical capacity due to unsuitable conditions. This is consistent with BOEM's Oil and Gas Program, which does not assume all areas leased will be explored and developed.

1.2.1.2.4. *State Capacity Commitment for Offshore Wind*

As shown on Figure 1.2-1 and Table 1.2-1, the state pledges for offshore wind capacity currently total about 29 GW (third bar on Figure 1.2-1). Unless otherwise specified, all tables referenced in this chapter are in Appendix B. The offshore wind capacity associated with each state in Table 1.2-1 is divided among awarded, scheduled, and planned but unscheduled procurements. This total capacity is specific to offshore wind and does not include more general renewable or clean energy goals. Out of the three categories of commitments, offtake awards provide the greatest certainty for development, followed by announced, scheduled solicitations. State goals that are planned but do not have a scheduled award or procurement dates could occur as a series of procurements, or simply not be met if future cost reductions do not meet the states' award criteria. Some states have clauses requiring state boards or commissions to only approve offshore wind procurements if determined in the public interest or in the best interest of ratepayers. If offshore wind offtake is not awarded due to the cost of offshore wind subsidies or for other reasons, the planned state procurements would not be fully realized. Furthermore, state commitments for offshore wind development may not be met for lack of available lease area or technical capacity. BOEM considers only 22 GW of all state capacity commitments to be reasonably foreseeable, after accounting for such limitations on state commitments, particularly those that exceed what is technically achievable in existing lease areas within transmission range with existing technology (fifth bar on Figure 1.2-1).

BOEM estimates the years of planned capacity as shown in Table 1.2-1. The technology available to meet future procurements may be quite different in 10 or more years than what is available today.

1.2.1.2.5. *Offshore Wind Offtake Awarded and Solicitations Announced*

A total of 6.4 GW has been awarded to meet state offshore wind procurements. Announced solicitations are those that have not yet been awarded but that a state has scheduled to award. Combined awarded and announced offshore wind procurements total 13.8 GW (see awarded or announced procurements in Table 1.2-1). This does not include state commitments that have been planned but are unscheduled. Those commitments are captured in the planned category.

[13] Industry appears to anticipate continuing the trend of increasing available turbine size over the next several years of development. The recently developed Haliade-X 12-MW turbine has a rotor diameter of 722 feet (220 meters), making the optimal turbine spacing for this machine approximately 0.83 nautical mile. BOEM assumes an average spacing of 1 nautical mile with an average turbine size of 12 MW (12 MW per square nautical mile [MW/nm²]) to calculate the total 25 GW active lease nameplate capacity.

[14] Existing wind energy leases in the Atlantic have been calculated by NREL to have an approximate capacity of about 21 GW (all lease areas developed at 10.3 MW/nm² [DOE 2019]). The actual capacity of a particular lease may vary (higher or lower) due to turbine sizes, turbine field density, or navigation corridors. Average offshore wind turbine size in U.S. waters should average at least 12 MW, and the largest turbines could exceed 15 MW before 2025. The build-out of Atlantic wind leases is likely to average more than 12 MW/nm² (if fully developed), assuming an average of 1 nautical mile spacing in all directions across wind leases (the widest spacing proposed by a developer for a project thus far).

1.2.1.2.6. Projects Announced

Lessees have publicly announced plans for additional projects in addition to the seven COPs BOEM is currently processing. Table 1.2-2 describes the current approved, proposed, and contemplated projects across all Atlantic lease areas. The capacity listed for a project corresponds to either the design envelope in its submitted COP or the size of procurements that the developer has publicly announced it would bid on.

Some developers have entered into offtake agreements before submitting a COP (e.g., Ocean Wind, Skipjack, and Sunrise), and some developers have submitted COPs before securing an offtake agreement (e.g., Bay State Wind and Vineyard Wind 1). BOEM considers a project that has submitted a COP with no offtake agreement more advanced than a project with only an offtake agreement and no COP submitted, because the former provide information needed for regulatory review. The information associated with announced projects varies, for example it might be a detailed submission to a procurement request for proposal, a company website with no specification beyond a general intention of development, or a general project area location and capacity.

1.2.2. Incorporation by Reference of the 2019 BOEM Study of Impact-Producing Factors

BOEM has completed a study of impact-producing factors (IPFs) on the North Atlantic OCS to consider in an offshore wind development cumulative impacts scenario (BOEM 2019a). That study is incorporated in this documented by reference. The study identifies cause-and-effect relationships between renewable energy projects and resources potentially affected by such projects. It further classifies those relationships into a manageable number of IPFs through which renewable energy projects could affect resources. It also identifies the types of actions and activities to be considered in a cumulative impacts scenario. The study identifies actions and activities that may affect the same physical, biological, economic, or cultural resources as renewable energy projects and states that such actions and activities may have the same IPFs as offshore wind projects. Table 1.2-3 provides a brief description of the primary IPFs involved in this analysis; some IPFs include multiple sub-IPFs. The IPFs are used in the impacts analysis and are project-specific in the text when applicable. Refer to Table 1.2-3 for more detailed definitions used in the 2019 study.

The BOEM (2019a) study identifies the relationships between IPFs associated with specific past, present, and reasonably foreseeable actions and activities in the North Atlantic OCS to consider in a NEPA cumulative impacts scenario. These IPFs and their relationships were utilized in the SEIS analysis of cumulative impacts and the application of which IPF applied to which resource was decided by BOEM. If an IPF was not associated with the Vineyard Wind 1 Project, it was not included in the cumulative impacts analysis. The one exception to this was the inclusion of Climate Change IPFs. This SEIS identifies specific actions and activities in Appendix A.

As discussed in the BOEM (2019a) study and the Draft EIS, reasonably foreseeable activities other than offshore wind projects may also affect the same resources as the proposed Project or other offshore wind projects, possibly via the same IPFs or via IPFs through which offshore wind projects do not contribute. Draft EIS Appendix C lists reasonably foreseeable non-offshore wind activities that may contribute to the cumulative impacts of the proposed Project. This SEIS does not attempt to repeat those descriptions and analyses, but it does consider them when evaluating the total cumulative impacts on a resource. Refer to Appendix A of this SEIS for details.

1.2.3. Resource Geographic Analysis Area

Each resource has a geographic distribution and area in which effects of the proposed Project would be felt. Appendix A describes the geographic analysis area and provides figures depicting the geographic analysis area for each resource; identifies reasonably foreseeable wind energy projects and other activities in addition to the proposed Project that are or could be located within the geographic analysis areas depicted; and includes a cumulative impact scenario for each resource that considers impacts from these projects and activities collectively.[15]

[15] These resource-specific geographic analysis areas are largely the same as presented in the Draft EIS (Appendix A gives reasons for the few that have been revised).

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1. OVERVIEW OF ALTERNATIVES

This chapter describes six action alternatives (one of which has two sub-alternatives) and the No Action Alternative for the proposed Project (Table 2.1-1). Alternatives B, C, D, E, and G are defined the same as in the Draft EIS Sections 2.1.2 through 2.1.6. This SEIS includes the addition of a Vessel Transit Lane Alternative, Alternative F. In addition, changes have been made to the proposed Project since publication of the Draft EIS, and these changes are described in Section 2.2. To the extent they are applicable, the changes to the proposed Project (revised Project Design Envelope [PDE]) are also analyzed in the action alternatives assessed in this document, although the description of each individual alternative has not changed since the Draft EIS (Section 2.2). The Draft EIS discusses the construction, operations and maintenance, and eventual decommissioning of the proposed Project under each of the previously analyzed action alternatives and provides additional details and assumptions for each of the alternatives for assessing potential impacts.

Additionally, Section D.1 in Appendix D discusses action alternatives that were considered but not analyzed in detail. The summary of the Proposed Action and the alternative analyses in this SEIS do not assume that the proposed mitigation measures discussed in the Draft EIS would be included to avoid or reduce potential impacts, but do include those measures voluntarily committed to by Vineyard Wind as part of the Proposed Action.

Table 2.1-1: Alternatives Considered For Analysis

Alternative	Description
Alternative A—Proposed Action	Under Alternative A, the Proposed Action, the construction, operation, maintenance, and eventual decommissioning of an up to 800 MW wind energy facility on the OCS offshore Massachusetts within the proposed Project area and associated export cables would occur within the range of design parameters outlined in the Vineyard Wind COP (Epsilon 2018a, 2019a, 2020a), subject to applicable mitigation measures.
Alternative B—Covell's Beach Cable Landfall Alternative	Under Alternative B, the Covell's Beach Cable Landfall Alternative, the construction, operation, maintenance, and eventual decommissioning of an up to 800 MW wind energy facility on the OCS offshore Massachusetts within the proposed Project area and associated export cables would occur within the range of the design parameters outlined in the Vineyard Wind COP, subject to applicable mitigation measures. However, the New Hampshire Avenue landfall location option presented in the COP would not be used, and the cable landfall would be limited to Covell's Beach to potentially reduce impacts on environmental and socioeconomic resources.
Alternative C—No Surface Occupancy in the Northern-Most Portion of the Project Area Alternative	Under Alternative C, the No Surface Occupancy in the Northern-Most Portion of the Project Area Alternative, the construction, operation, maintenance, and eventual decommissioning of an up to 800 MW wind energy facility on the OCS offshore Massachusetts within the proposed Project area and associated export cables would occur within the range of the design parameters outlined in the Vineyard Wind COP, subject to applicable mitigation measures. However, no surface occupancy would occur in the northern-most portion of the proposed Project area to potentially reduce the visual impacts of the proposed Project and potential conflicts with existing ocean uses, such as, marine navigation and commercial fishing. This alternative would result in the exclusion of approximately six of the northern-most WTG locations.
Alternative D—Wind Turbine Layout Modification Alternative	Under Alternative D, the Wind Turbine Layout Modification Alternative, the construction, operation, maintenance, and eventual decommissioning of an up to 800 MW wind energy facility on the OCS offshore Massachusetts within the Vineyard Wind lease area and associated export cables would occur within the range of the design parameters outlined in the Vineyard Wind COP, subject to applicable mitigation measures. However, modifications would be made to the wind turbine array layout to potentially reduce impacts on existing ocean uses, such as commercial fishing and marine navigation. Each of the below sub-alternatives may be individually selected or combined with any or all other alternatives or sub-alternatives.
Alternative D1—One-Nautical Mile Wind Turbine Spacing Alternative	Under Alternative D1, WTGs would have a minimum spacing of 1 nautical mile between them and the lanes between turbines would also be a minimum of 1 nautical mile to potentially reduce conflicts with existing ocean uses, such as commercial fishing and marine navigation.
Alternative D2—East-West and One-Nautical Mile Wind Turbine Layout Alternative	Under Alternative D2,[1] the wind turbine layout would be arranged in an east-west orientation and all WTGs in the east-west direction would have a minimum spacing of 1 nautical mile between them to allow for vessels to travel in an unobstructed path between rows of turbines in an east-west direction. This alternative would potentially reduce conflicts with existing ocean uses, such as commercial fishing, by facilitating the established practice of mobile and fixed gear fishing practices and vessels fishing in an east-west direction.
Alternative E—Reduced Project Size Alternative	Under Alternative E, the Reduced Project Size Alternative, the construction, operation, maintenance, and eventual decommissioning of a large-scale commercial wind energy facility on the OCS offshore Massachusetts within the proposed Project area and associated export cables would occur within the range of the design parameters outlined in the Vineyard Wind COP, subject to applicable mitigation measures, with the following exception: the proposed Project would consist of no more than 84 WTGs in order to potentially reduce impacts on existing ocean uses and environmental resources.

[1] Small variances throughout a wind farm should not significantly affect safety of navigation. The 2020 draft Massachusetts and Rhode Island Port Access Route Study (MARIPARS; USCG 2020) provided quantitatively derived recommendations for turbine spacing and transit lane widths within the wind arrays. For an array developed in a uniform grid, aligned along cardinal headings with 1 nautical mile spacing, the diagonal lanes would be approximately 0.7 nautical mile wide. The MARIPARS recommended that diagonal lanes be 0.6 to 0.8 nautical mile wide. Any movements in turbine location should not shrink the diagonal lanes to less than 0.6 nautical mile.

Alternative	Description
Alternative F—Vessel Transit Lane Alternative	Under Alternative F, a vessel transit lane through the WDA would be established in which no surface occupancy would occur. The lane included in this alternative, and not included in other alternatives, could potentially facilitate transit of vessels through the project area from southern New England ports—primarily New Bedford—to fishing areas on Georges Bank. WTG locations displaced by the transit lane would not be eliminated from consideration, but are assumed to move the proposed Project south of the WDA. This alternative will disclose the effect a transit lane could have on the expected effects from the other action alternatives analyzed in this EIS.
Alternative G—No Action Alternative	Under Alternative G, the No Action Alternative, the proposed Project and associated activities as described in the Vineyard Wind COP would not be approved and the proposed construction, operation, maintenance, and decommissioning activities would not occur. Any potential environmental and socioeconomic costs and benefits associated with the proposed Project as described under Alternative A, the Proposed Action, would not occur.

COP = Construction and Operations Plan; MW = megawatt; OCS = Outer Continental Shelf; WDA = Wind Development Area; WTG = wind turbine generator

2.2. Changes to the Project Design Envelope and Alternatives Since Publication of the Draft EIS

2.2.1. Project Updates

Vineyard Wind's COP (Epsilon 2018a, 2019a, 2020a) and the Draft EIS Section 2.1.1 and Appendix E describe the Project specifications under a PDE concept that allows a reasonable degree of flexibility in the selection and purchase of proposed Project components such as WTGs, foundations, and submarine cables. Since publication of the Draft EIS, Vineyard Wind has submitted an updated COP with minor changes to the PDE to allow for the possibility of using WTGs of higher capacity (Epsilon 2020a). Vineyard Wind has not changed the lower limit of WTG capacity in the PDE; thus, the Project could still utilize up to 100 WTGs as evaluated in the Draft EIS. Table 2.2-1 details the changes to the limits of the PDE, and Appendix E of this SEIS provides additional information as an update to the Draft EIS Appendix G.

Table 2.2-1: Changes to the Limits of the Proposed Project Design Envelope

Envelope Parameter	Previous Limit	Current Limit
Total Number of Turbines	Up to 100	57 to 100
Total Facility Capacity	~800 MW [a]	~800 MW [a]
Maximum Turbine Generation Capacity	10 MW	14 MW
Maximum Tip Height	696 feet (212 meters) MLLW [b]	837 feet (255 meters) MLLW [b]
Maximum Hub Height	397 feet (121 meters) MLLW [b]	473 feet (144 meters) MLLW [b]
Maximum Rotor Diameter	591 feet (180 meters) MLLW [b]	729 feet (222 meters) MLLW [b]
Maximum Tip Clearance	102 feet (31 meters) MLLW [b]	105 feet (32 meters) MLLW [b]
Substation Footprint	6.4 acres (25,899.9 m^2)	8.6 acres (34,803.1 m^2)

m^2 = square meters; MLLW = above mean lower low water; MW = megawatt

[a] Vineyard Wind's Proposed Action is for an 800-MW offshore wind energy project. This SEIS evaluates the potential impacts of a facility up to 800 MW to ensure that it covers projects constructed with a smaller capacity.

[b] Elevations relative to mean higher high water are approximately 3 feet (1 meter) lower than those relative to MLLW.

As summarized below, the updated Vineyard Wind PDE results in slight changes in the possible outcomes under each alternative when compared to the Draft EIS.

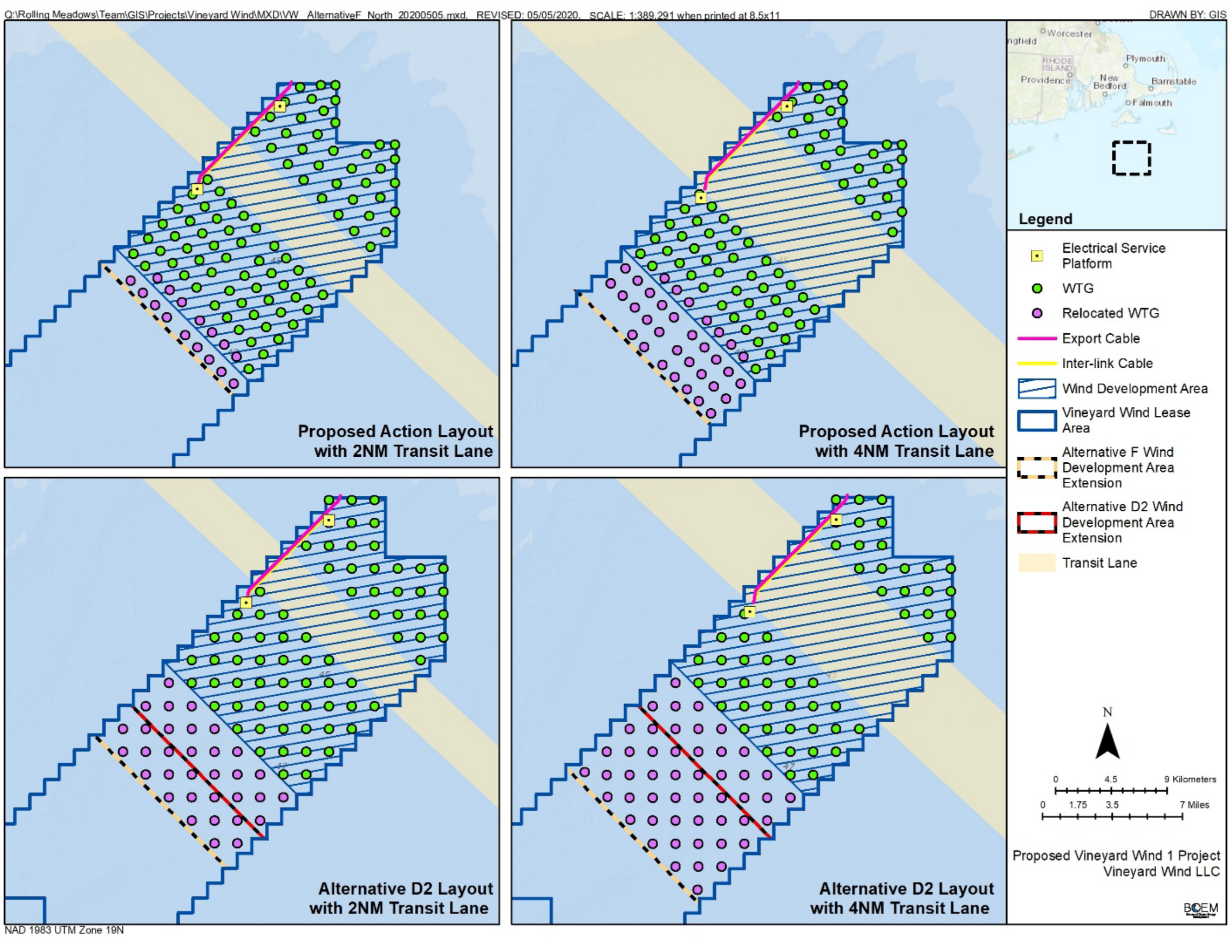
- Alternative A: The proposed Project could use higher nameplate capacity WTGs, up to 14 MW (Table 2.2-1). Depending on the turbine capacity used, the proposed Project could involve as few as 57 WTGs or as many as 100 WTGs.
- Alternatives B, C, and D: Changes are the same as those for Alternative A.
- Alternative E: The proposed Project could use larger turbines, within the limits of the revised PDE (Table 2.2-1). Depending on the turbine capacity used, the proposed Project could involve as few as 57 WTGs or as many as 84 WTGs. As discussed in the Draft EIS, this alternative would still allow Vineyard Wind to select any of the 106 proposed WTG positions.
- Alternative G (discussed as Alternative F in the Draft EIS): No change.

In addition, Vineyard Wind has proposed an expansion of the proposed onshore substation since the Draft EIS was published (Table 2.2-1). For the expanded substation area, the total approximate area of ground disturbance would be 7.7 acres (31,161 square meters [m^2]), or 1.8 acres (7,122 m^2) greater than the 5.9 acres (23,877 m^2) assumed in the Draft EIS. The majority of ground disturbance would occur in previously disturbed (paved) areas where no tree clearing would be needed (potentially 0.2 acre [809 m^2] may require tree clearing). The southern portion of the expanded substation area is wooded, and an additional 0.2 acre [809 m^2] may need to be cleared, for a total of 6.1 acres (24,686 m^2) of tree clearing. This 6.1 acres (24,686 m^2) of tree clearing is within the estimated 7 acres (28,328 m^2) of tree clearing analyzed in the Draft EIS. BOEM analyzed the impacts of this change to the proposed Project under the appropriate resource area sections within this SEIS.

2.2.2. New Alternative Considered since Publication of the Draft EIS

Since the Draft EIS was published, a new alternative has been added and analyzed in this Supplemental EIS.[2] Alternative F, Vessel Transit Lane Alternative, includes a new vessel transit lane in response to the January 3, 2020, Responsible Offshore Development Association (RODA) layout proposal (Figure 2.2-1) (RODA 2020). The RODA proposal includes designated transit lanes, each at least 4-nautical miles wide (Figure 2.2-2). Although the proposal includes six total transit lanes, only one intersects the Vineyard Wind 1 Project Wind Development Area (WDA), as shown in Figure 2.2-1, the action for which this EIS is being prepared. The purpose of the proposed northwest/southeast transit corridor would be mainly to facilitate vessel transit from southern New England ports—primarily New Bedford—to fishing areas on Georges Bank.

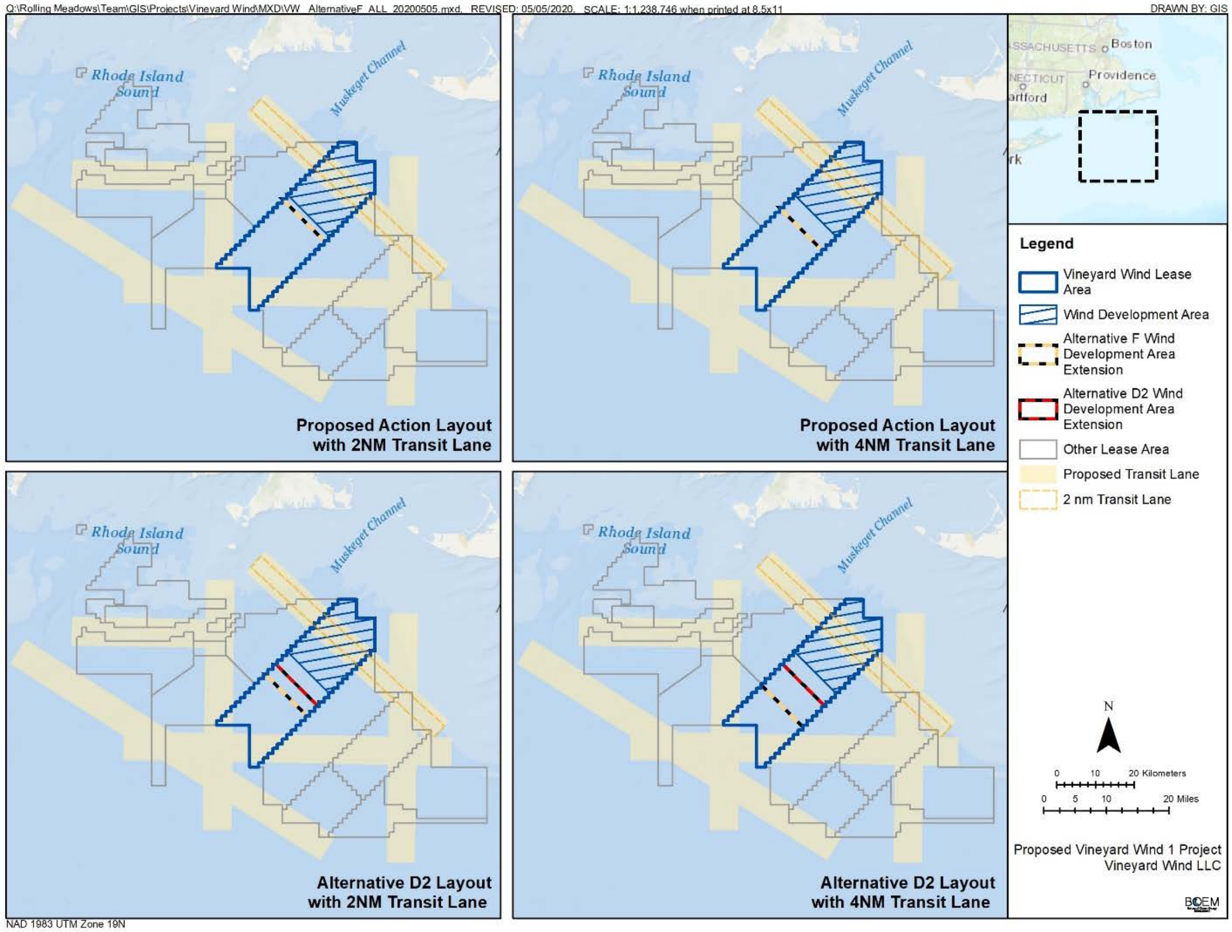
The WTGs that would have been located within the transit lane proposed to intersect the WDA would not be eliminated from the Proposed Action; but instead, the displaced WTGs would be shifted south within the Vineyard Wind lease area. Therefore, the number of placement locations would remain the same as assumed under the Proposed Action. Under Alternative F, a 2- and a 4-nautical mile transit lane are analyzed by BOEM to provide the U.S. Secretary of the Interior with an assessment that is representative of transit lanes from 1 to 4 nautical miles wide. In this analysis, BOEM considers the effect of the single transit lane through the WDA on all alternatives considered, but focuses on the direct and indirect impacts from the combination of the new Alternative F with Alternative A and Alternative D2 because these analyses are expected to be similar to combinations with the other alternatives. The placement location of the transit lane assessed in this analysis (Figure 2.2-1) is based on the submission from RODA. In addition, this location would be the most impactful scenario. BOEM's decision maker could select this alternative and locate the lane elsewhere in the lease area. In addition, this SEIS considers the other five transit lanes that would intersect the other reasonably foreseeable project areas to the extent that the impacts of those additional lanes would contribute to cumulative impacts in the analysis area considered for each resource area assessed.



Note: The layouts shown are for illustrative purposes only.

Figure 2.2-1: Alternative F—Vessel Transit Lane Alternative

[2] This new alternative describes "transit lanes" as requested by the RODA. BOEM has no legal authority to require vessels to transit particular lanes through the proposed Project, although BOEM can manage the placement of structures attached to the seabed. That noted, this document will use the term "transit lane" throughout in discussion concerning Alternative F.



Note: The layouts shown are for illustrative purposes only.

Figure 2.2-2: Alternative F—Vessel Transit Lane Alternative with Six Transit Lanes

The direct and indirect impacts associated with the establishment of a transit lane through the lease area are considered separately for each resource in Chapter 3 and Appendix A, with special focus on the most potentially affected resources such as navigation and commercial fishing. To help comply with the page limits in the Department of the Interior's Secretarial Order 3355 and focus on the impacts of most concern, BOEM has included the analysis of resources with no greater than minor direct or indirect effects in Appendix A. In addition, the cumulative impacts of additional transit lanes are analyzed where the additional lanes intersect with a resource's geographic analysis area. BOEM's impact assessment for this new alternative includes the following assumptions (Figure 2.2-1):

- There would be no changes to the total number of WTGs or electrical service platforms (ESPs).
- One of the two ESPs presented in the PDE could be located further south than anticipated under the Proposed Action.
- The Offshore Export Cable Corridor (OECC) routes would be longer due to shifting project elements further into the southern portion of the lease area.
- The acreage of the WDA throughout which Project components would be distributed could increase by up to 61 percent depending on the option selected.
- The amount and length of inter-array cabling would increase and exceed the maximum design parameter in the Vineyard Wind COP PDE of 171 miles (275 kilometers) due to shifting WTGs further south in the lease area. The total length of inter-array cabling is estimated to be between 221 and 234 miles (355 and 376 kilometers) (Michael Clayton, Pers. Comm., March 24, 2020) depending on the width of the transit lane, number of WTGs utilized, and WTG arrangement within the WDA. This would result in up to a 37 percent increase of additional inter-array cabling.
- The Proposed Action Layout with the implementation of a 2-nautical mile transit lane would result in the following:
  - Out of a total of 2 ESPs and 106 WTG placement locations, up to 16 WTG placements would be relocated outside the proposed transit lane. Of these, 7 WTG placements would be relocated to the southern portion of the WDA, and 9 would be outside the WDA.
  - Acreage increase of the WDA throughout which Project components would be distributed: 12 percent.
- Proposed Action Layout with the implementation of a 4-nautical mile transit lane would result in the following:
  - Out of a total of 2 ESPs and 106 WTG placement locations, up to 1 ESP and 34 WTG placements would be relocated outside the proposed transit lane. Of these, 7 WTG placements would be relocated to the southern portion of the WDA, and 27 would be outside the WDA.
  - Acreage increase of the WDA throughout which Project components would be distributed: 25 percent.

- Alternative D2 Layout (1 nautical mile by 1 nautical mile spacing) with the implementation of a 2-nautical mile transit lane would result in the following:
  - Out of a total of 2 ESPs and 106 WTG placement locations, up to 16 WTG placements would be relocated outside the proposed transit lane, and a total of 33 placements would be relocated outside the WDA.
  - Acreage increase of the WDA throughout which Project components would be distributed: 41 percent.
- Alternative D2 Layout (1 nautical mile by 1 nautical mile spacing) with the implementation of a 4-nautical mile transit lane would result in the following (this is equivalent to the RODA layout proposal):
  - Out of a total of 2 ESPs and 106 WTG placement locations, up to 1 ESP and 33 WTG placements would be relocated outside the proposed transit lane, and a total of 50 placements would be outside the WDA.
  - Acreage increase of the WDA throughout which Project components would be distributed: 61 percent.

Just as implementation of Alternatives D1 or D2 would pose some unique challenges (as described in the Draft EIS Chapter 2) so too could implementation of Alternative F. In addition to the assumptions specified above as they relate to the impact assessment presented in Chapter 3 of this SEIS, BOEM has considered the following technical and practical challenges associated with Alternative F.

- Implementation of Alternative F would delay proposed Project construction if significant additional survey work is required. Additional site characterization surveys for Alternative F, if required, would be similar to those described in Section 3.1.3 of BOEM 2012a, with the attendant environmental impacts described in Section 4.2 of BOEM 2012a.
- Vineyard Wind's proposed 66-kilovolt inter-array cables would experience additional transmission loss if cables are lengthened to accommodate the transit lanes assumed under Alternative F. Such transmission losses are not considered as part of the Project design and could translate to technical difficulties and additional unanticipated costs.
- Cable lengthening would require factory joints, which are not currently technically possible by cable manufacturers. Joints could increase the risk of potential cable failure, and repairing such failures could lead to increased environmental effects due to a variety of factors including bottom disturbance and vessel traffic.
- The space required for implementation of the transit lane could reduce the area available for Vineyard Wind to construct future projects within the lease area.

In addition, BOEM has considered the following technical and practical challenges of Alternative F as they relate to the assessment of cumulative impacts:

- If all six transit lanes proposed by RODA were implemented, the technical capacity of offshore wind power generation assumed in Chapter 1 would not be met. The magnitude of the diminished technical capacity would depend on the width of transit lanes implemented, but ultimately, less clean energy in the region would be produced. BOEM assumes this to be true of any combination of alternatives that includes Alternative F. As explained in Section 3.14.2.4, BOEM assumes that the addition of all six of the 4-nautical mile transit lanes proposed by RODA would reduce the technical capacity of the Rhode Island and Massachusetts (RI and MA) Lease Areas[3] by approximately 3,300 MW, which is 500 MW less than the current state demand for offshore wind in the area. Furthermore, Alternative F combined with the Alternative D2 layout would not be able to meet existing announced demand as described in Chapter 1.
- Independent of the Proposed Action, and after publication of the Draft EIS, Vineyard Wind and other Rhode Island and Massachusetts offshore wind leaseholders have committed to implementing a 1 by 1 nautical mile WTG grid layout in east-west orientation (equivalent to Alternative D2) in response to stakeholder feedback. The developers' agreement was reached in order to avoid irregular transit corridors. This agreement alone has resulted in significant reductions in the area available for offshore wind development. BOEM recognizes that implementation of Alternative could further erode project economics and viability.
- The potential construction delays described above could create more overlap with other future offshore wind projects' construction schedules, potentially leading to increased cumulative impacts on resources that are sensitive to overlapping construction activities.

In addition, the USCG's Draft Massachusetts and Rhode Island Port Access Route Study (Draft MARIPARS report; USCG 2020), evaluating the need for establishing vessel routing measures, was published on January 29, 2020 (85 Fed. Reg. 5222). The Draft MARIPARS report recommended an aligned, regular, and gridded layout throughout the Rhode Island and Massachusetts Lease Areas (RI and MA Lease Areas) that provides adequate sea room to facilitate predictable safe navigation throughout the contiguous leases. The recommendation includes three "lines of orientation," or predictable headings that vessels can take at any location within the contiguous lease areas. The Draft MARIPARS report stated that 1-nautical-mile wide east-to-west paths would facilitate traditional fishing methods in the area, and 1-nautical-mile-wide north-to-south paths would provide the USCG with adequate access for search and rescue access. Finally, the Draft MARIPARS report found that the 0.6- to 0.8-nautical-mile-wide northwest-to-southeast paths would allow commercial fishing vessels to continue their travel from port through the lease areas and to fishing grounds. These 0.6- to 0.8-nautical mile paths could be utilized by other vessels as well. As described above, the five Rhode Island and Massachusetts offshore wind leaseholders have proposed a collaborative regional layout for wind turbines (1 by 1 nautical mile apart in fixed east-to-west rows and north-to-south columns, with 0.7-nautical-mile theoretical transit lanes oriented northwest-southeast) across their respective BOEM leases (Geijerstam et al. 2019), which meets the layout rules set forth in the Draft MARIPARS report recommendations. The RODA proposal (RODA 2020), which recommends additional transit lanes through lease areas, was attached to the MARIPARS Federal Register Docket. However, the Draft MARIPARS report concluded that if the recommended layout was met, the USCG would not pursue any additional routing measures. As cooperating agencies, BOEM and USCG will continue

[3] The RI and MA Lease Areas are comprised of OCS-A 0486 Revolution Wind, OCS-A 0517 South Fork, OCS-A 0500 and 0487 Sunrise Wind, OCS-A 0500 Bay State Wind, OCS-A 501 Vineyard Wind, OCS-A 0520 Equinor Wind, OCS-A 0521 Mayflower Wind, and OCS-A 0522 Liberty Wind.

to consult over the course of the NEPA process for the proposed Project and alternatives as it relates to navigational safety and other aspects. The USCG has stated that it will make a final recommendation on transit routes after the comments received during the Draft MARIPARS report comment period are assessed.

NEPA requires agencies to consider a range of alternatives, including: 1) alternatives rigorously explored and objectively evaluated in the EIS, and 2) alternatives eliminated from detailed study with a brief discussion of the reasons for elimination. Reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant. Despite the technical, operational, and economic challenges that Alternative F would present if selected, this Alternative could technically and economically meet the purpose and need. If alternatives are eliminated from further analysis, an EIS should briefly discuss the reasons for their elimination (40 CFR 1502.14(a)). A transit lane alternative was eliminated in the Draft EIS because locations previously discussed did not intersect the WDA. Since the transit lane now proposed by RODA does intersect the WDA, the previous reason for elimination is no longer applicable. For these reasons, BOEM has elected to fully evaluate RODA's proposed layout in this SEIS and the Final EIS.

2.3. SUMMARY AND COMPARISON OF IMPACTS BY ALTERNATIVES

Table ES-2 provides a summary and comparison of the direct, indirect, and cumulative impacts under each action alternative assessed in Chapter 3. The impact analysis of resources with an overall minor impact level (green) are located in Appendix A. Tables 3-1 and 3-2 in Appendix B provide definitions for negligible, minor, moderate, and major impacts. 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 to the table. Although the detailed description of potential impacts could vary across action alternatives, as described in Chapter 3, many of the differences in potential impacts across alternatives do not warrant differences in the impact ratings determined based on the definitions used.

Under Alternative G (No Action), any potential environmental and socioeconomic impacts, including benefits, associated with the proposed Project would not occur; however, impacts could occur from other activities as described in Chapter 3 and Appendix A.

3. ENVIRONMENTAL CONSEQUENCES

This chapter reviews resource-specific baseline conditions, considers future offshore wind activities, and, using the methodology and assumptions outlined the Chapter 1 and Appendix A, assesses cumulative impacts that could result from the incremental impact of the Proposed Action and action alternatives when combined with other past, present, or reasonably foreseeable actions. This chapter is intended to supplement Chapter 3 of the Draft EIS and relies on information and analysis presented in that document and data made available since the publication of that document. This Chapter incorporates the Draft EIS material by reference along with the BOEM Report *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf* (BOEM 2019a). Where information was incomplete or unavailable for the evaluation of reasonably foreseeable impacts analyzed in this chapter, BOEM identified that information and conducted its analysis in accordance with Section 1502.22 of the CEQ regulations. The findings of this assessment are presented in Appendix C.

The detailed activities scenario used by the No Action Alternative (Alternative G) and cumulative analyses in this chapter and the associated assumptions can be found in Appendix A and Section 1.2.1.1. Specifically, the scenario developed to quantitatively analyze impacts (where feasible) can be found in the Table A-4 in Appendix A. The scenarios vary based on the geographic analysis area for a particular resource. As mentioned below, the geographic analysis area for (1) the analysis of impacts due to the Vineyard Wind 1 Project and (2) the analysis of cumulative impacts is the same for each resource (Section 1.2.3 for additional detail).

BOEM assumes that if the total offshore wind power generating capacity assumed in Chapter 1 is not met, the adverse and beneficial impacts of reasonably foreseeable offshore wind projects as well as the cumulative effects of the proposed Project would likely be less.

The main subsections within this chapter are organized by resource. Within each resource, BOEM analyzes the effects of the No Action alternative, followed by the potential cumulative effects of the Proposed Action and action alternatives. The following describes the content of each.

No Action Alternative: A summary of the baseline conditions as well as the reasonably foreseeable impacts of ongoing activities, future offshore activities (not including offshore wind), and future offshore wind activities (not including the Proposed Action) on each resource are provided in each subsection of this chapter. The analysis of impacts under the No Action Alternative assumes that best management practices (BMPs) incorporated from the ROD on the 2007 *Final Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf*, will be implemented for future offshore wind activities (MMS 2007a). A summary of the BMPs can be found in Table A-5 in Appendix A of this SEIS.

Table A-1 in Appendix A provides a description of the geographic analysis area for each resource and Figures A.7-1 through A.7-16 in Appendix A depict the geographic analysis area for each potentially impacted resource. These geographic analysis area boundaries remain largely unchanged from the Draft EIS. For boundaries that have changed from the Draft EIS, Table A-1 in Appendix A provides the reasoning.

Under the No Action Alternative, the impacts from the proposed Project would not occur as proposed. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. The No Action Alternative analysis of this SEIS assumes that if the Vineyard Wind 1 Project is not approved, state demand would be met through other projects built elsewhere in the RI and MA Lease Areas. Therefore, depending on the size of the geographic analysis area for a particular resource, the total amount of development in the geographic analysis area may or may not differ with or without the Proposed Action. To assist with the analysis, this SEIS divides resources into two categories.

- Resources with an “expansive” geographic area have an analysis area that either includes all of the RI and MA Lease Areas or is independent of all wind lease areas. In this case, the Massachusetts state demand that the Vineyard Wind 1 Project would fill, if approved, could still be met by other projects and could cause impacts on resources within the geographic analysis area. Overall impacts under the No Action Alternative could be similar in type and amount with or without the Proposed Action, although the exact impacts associated with meeting the Massachusetts state demand could vary due to temporal and geographic differences.
- Resources with a “restricted” geographic area have an analysis area restricted to a subset of the RI and MA Lease Areas, including the proposed Project area at a minimum, and excluding substantial portions of some lease areas and unleased areas. In this case, BOEM assumes that impacts on the resources are likely to be less if the No Action Alternative is chosen because without the Vineyard Wind 1 Project, other development to meet Massachusetts state demand is likely to have less impact within the geographic analysis area defined for resource analysis.

Resources with an “expansive” area include the following:

- Finfish, Invertebrates, and EFH (Section 3.4)
- Marine Mammals (Section 3.5)
- Sea Turtles (Section 3.6)
- Demographics, Employment, and Economics (Section 3.7)
- Environmental Justice (Section 3.8)
- Cultural Resources (Section 3.9)
- Recreation and Tourism (Section 3.10)
- Commercial Fisheries and For-Hire Recreational Fishing (Section 3.11)
- Land Use and Coastal Infrastructure (Section 3.12)
- Navigation and Vessel Traffic (Section 3.13)
- Other Uses (Section 3.14)

- Birds (Appendix A, Section A.8.3)
- Bats (Appendix A, Section A.8.4)

Resources with a "restricted" area include the following:

- Benthic Resources (Section 3.3)
- Air Quality (Appendix A, Section A.8.1)
- Water Quality (Appendix A, Section A.8.2)

There are also two resources, Terrestrial and Coastal Fauna (Section 3.1) and Coastal Habitats (Section 3.2) with geographic analysis areas that are particularly small and for which potential cumulative impacts depend primarily on specifics of the proposed Project. Future offshore wind projects might impact the two resources within the geographic analysis area defined, but information to quantify such impacts is lacking and hence these impacts are assessed qualitatively in this SEIS.

Furthermore, and as referenced in the listing presented above, BOEM's assessment of effects on air quality, water quality, birds, and bats has indicated no greater than minor direct and indirect effects. To help comply with the page limits in the Department of the Interior's Secretarial Order 3355 and focus on the impacts of most concern, BOEM has included the analysis of these resources in Appendix A. Additionally, unless otherwise specified, all tables referenced in this chapter are included in Appendix B.

Proposed Action and Action Alternatives: A summary of the cumulative impacts (including magnitude, intensity, and timeline) of the Proposed Action and action alternatives when combined with ongoing activities, future non-offshore wind activities, and future offshore wind activities described under the No Action Alternative is provided below. Any changes to the Proposed Action impacts from expansion of the PDE (as described in Chapter 2) and the new Alternative F (Vessel Transit Lane) are analyzed in detail below. In addition, Chapter 3 analyzes any IPF not presented in the Draft EIS.

As part of the proposed Project, Vineyard Wind has committed to voluntarily implement measures to avoid, reduce, or monitor impacts on the resources discussed in Chapter 3 of the Draft EIS. Said mitigation and monitoring measures are summarized in the Vineyard Wind COP, Volume III, Table 4.2-1 and 4.2-2 (Epsilon 2018a). As part of the Proposed Action, BOEM considers only those measures that Vineyard Wind has committed to in the Vineyard Wind COP. BOEM may select alternatives and/or require additional mitigation or monitoring measures to further protect and monitor these resources. The mitigation and monitoring measures that Vineyard Wind has committed to implement as well as those that may result from reviews under applicable statutes are shown in Appendix D, Table D-1 of the Draft EIS and are incorporated in this analysis.

The impacts analysis is based on a maximum-case scenario; if Vineyard Wind were to implement a less impactful scenario within the PDE, smaller amounts of construction or infrastructure development could result in lower impacts but would not likely result in different impacts than those described below.

As presented in the Draft EIS, this SEIS uses a four-level classification scheme to characterize the potential impacts of the alternatives, including the cumulative effects of each alternative. Table 3-1 provides adverse and Table 3-2 provides beneficial impact levels for all biological, physical, and socioeconomic resources that the proposed Project and alternatives could potentially affect. The SEIS specifies beneficial impact determinations as appropriate. If a determination presented in this document does not state that the impact is beneficial, it should be assumed that the effect is adverse. In addition, this SEIS provides information related to the magnitude, duration, geographic extent, and frequency of potential impacts, as appropriate, to support impact determinations.

As specified previously, BOEM's analysis utilizes resource-specific assumptions in order to assess the most impactful scenarios for potential effects. Table 3-3 provides a summary of the maximum-case WTG scenario applicable to each resource discussed in Chapter 3 and Appendix A.

3.1. Terrestrial and Coastal Fauna

3.1.1. No Action Alternative Impacts

Table 3.1-1 contains a detailed summary of baseline conditions and the impacts of ongoing and future offshore activities other than offshore wind on terrestrial and coastal fauna, based on the IPFs assessed. This information comes primarily from the Draft EIS. The impact analysis is limited to impacts within the terrestrial and coastal fauna geographic analysis area as described in Table A-1 and shown on Figure A.7-1 in Appendix A. Specifically, this includes only the area within a 0.5-mile (0.8-kilometer) buffer around all land areas that would be disturbed by the proposed Project.

The terrestrial and coastal fauna geographic analysis area is dominated by developed land and pine-oak forest. Pine-oak forest is one of the most common habitat types on Cape Cod. Terrestrial fauna have access to high quality, unfragmented habitat in the 365-acre (1.5-km^2) Hyannis Ponds Wildlife Management Area (WMA). Much of the other habitat in the geographic analysis area is already fragmented and/or developed for human uses. Ongoing activities related to land disturbance periodically affect terrestrial and coastal fauna in the geographic analysis area. For example, ground-disturbing activities contribute to elevated levels of erosion and sedimentation, but not to a degree that affects terrestrial and coastal fauna. Periodic clearing of shrubs and tree saplings along existing utility right-of-way (ROW) causes disturbance and temporary displacement of mobile species and may cause direct injury or mortality of less-mobile species, resulting in short-term impacts that are less than noticeable. Periodically, undeveloped parcels are cleared and developed for human uses, permanently changing the condition of those parcels as habitat for terrestrial fauna. Future development at a recently graded, bare site near the proposed eastern onshore cable route of the proposed Project may cause disturbance and displacement of fauna, resulting in temporary impacts that are less than noticeable. Climate change, influenced in part by greenhouse gas (GHG) emissions, is altering the seasonal timing and patterns of species distributions and ecological relationships, likely causing permanent changes of unknown intensity.

Under the No Action Alternative, the proposed Project would not be built and hence would have no impact on terrestrial and coastal fauna. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. A detailed analysis of impacts associated with future offshore wind development is provided in Section 3.1.1.1 and summarized in Table 3.1-1. Cumulative impacts of the Proposed Action and action alternatives are analyzed in Section 3.1.2.

3.1.1.1. Future Offshore Wind Activities (without Proposed Action)

Although BOEM is not aware of any future offshore wind activities other than the Proposed Action that would overlap the geographic analysis area for terrestrial and coastal fauna, it is conceivable that a future project could cross the geographic analysis area or even be collocated (partly or completely) within the same terrestrial ROW corridor that the Proposed Action would use; in such a case, the impacts of those future offshore wind activities on terrestrial and coastal fauna would of the same type as those of the Proposed Action.

3.1.1.2. Conclusions

The current state of terrestrial and coastal fauna resources is generally stable, although they are subject to disturbance from ongoing activities in the terrestrial and coastal fauna geographic analysis area. Land disturbance from onshore construction periodically causes temporary and permanent habitat loss, temporary displacement, injury and mortality, resulting in small short-term impacts on terrestrial and coastal fauna. Climate change, influenced in part by GHG emissions, is altering the seasonal timing and patterns of species distributions and ecological relationships, likely causing permanent impacts of unknown intensity.

Future offshore wind activities, if any enter the geographic analysis area for terrestrial and coastal fauna, could cause impacts on terrestrial and coastal fauna (e.g., displacement, mortality, habitat loss) that would be similar to the direct and indirect impacts of the proposed Project alone. Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in moderate adverse impacts through land disturbance, if future offshore wind activities even enter the geographic analysis area.

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impact on terrestrial and coastal fauna. However, future offshore wind activities could possibly result in impacts similar to those described in Draft EIS Section 3.3.1.3, and ongoing and future non-offshore wind activities would also have impacts. Considering current conditions and the modest pace of development in the geographic analysis area, terrestrial fauna resources are expected to remain generally stable under the No Action Alternative.

3.1.2. Proposed Action and Action Alternatives

3.1.2.1. Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on terrestrial and coastal fauna are described in Draft EIS Section 3.3.1.3, and additional information is included in Table 3.1-1. This section updates the analysis from the Draft EIS and then focuses on cumulative impacts. This discussion of terrestrial and coastal fauna does not include birds, which are discussed separately in Section A.8.3, or bats, which are discussed separately in Section A.8.4.

Direct and indirect impacts on terrestrial and coastal fauna would primarily occur through the IPF of land disturbance. Under the Proposed Action, there are several OECR options, and the impacts of the proposed Project on terrestrial and coastal fauna would depend upon which route was used. For example, one route option would pass through the relatively undisturbed Hyannis Ponds WMA, potentially leading to greater impacts than a route that passes through previously disturbed locations. Furthermore, the intensity of impacts on terrestrial and coastal fauna would depend on the time of year that onshore construction was to occur. Onshore construction of the proposed Project would cause disturbance, temporary displacement, and potential injury and/or mortality of terrestrial and coastal fauna on up to 15.8 acres (63,940 m^2), resulting in small temporary impacts during construction. The potential route option with the greatest amount of temporary habitat alteration (New Hampshire Avenue Variant 2) differs from the potential route option with the greatest amount of permanent habitat alteration (New Hampshire Avenue Variant 3; Epsilon 2018b). The route most preferred by Vineyard Wind (Covell's Beach Variant 1; Epsilon 2018b) lies entirely within existing road ROW and would have no impact on terrestrial habitat. If another route option were chosen, land use changes for the proposed Project could permanently convert up to 12.4 acres (50,181 m^2) of forest to developed land and managed grassland. The risk of affecting nearby wetland and stream habitats would be low, given that work would not occur in wetlands or streams and that standard construction BMPs would prevent sedimentation of wetlands or streams. Overall, the direct and indirect impacts of the Proposed Action on terrestrial and coastal fauna through land disturbance are expected to be moderate.

Changes to the design capacity of the WTGs proposed in the Vineyard Wind COP (Epsilon 2020a) would not alter the maximum-case scenario of potential impact on terrestrial and coastal fauna because it would not alter the onshore activities for the Proposed Action and all other action alternatives. Offshore components of the Proposed Action have no potential impacts on terrestrial and coastal fauna. Changes to the proposed onshore substation site could modify the impacts of the Proposed Action and all other action alternatives on terrestrial and coastal fauna. The Draft EIS assessed the potential impacts of building a substation of up to 7 acres (28,328 m^2) in size within a completely forested site. Vineyard Wind has increased the substation site area to 8.6 acres (34,601 m^2), of which only 7.7 acres (30,999 m^2) would involve ground disturbance, which could result in a slight increase in temporary displacement, habitat degradation, and potential injury or mortality of terrestrial fauna during construction activities. Of the 7.7 acres (30,999 m^2), only 6.1 acres (24,686 m^2) would involve tree clearing; the total amount of permanent habitat loss due to forest clearing at the substation site would remain within the 7-acre (28,328-m^2) maximum assessed in the Draft EIS Section 3.3.1.3. Considering these changes, the direct and indirect impacts of the Proposed Action and all other action alternatives on terrestrial and coastal fauna through land disturbance are still expected to be moderate.

The cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities would be of similar types as described in Section 3.1.1, but may differ in intensity and extent. The cumulative impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are listed by IPF in Table 3.1-1. Under the No Action Alternative, BOEM expects ongoing activities and future non-offshore wind activities to have continuing temporary to permanent impacts on terrestrial and coastal fauna, primarily through the IPFs of land disturbance and climate change. Although BOEM is not aware of any future offshore wind activities other than the Proposed Action that would overlap the geographic analysis area for terrestrial and coastal fauna, it is conceivable that a future project could cross the geographic analysis area or even be collocated (partly or completely) within the same terrestrial ROW corridor that the Proposed Action would use; in such a case, the impacts of those future offshore wind activities on terrestrial and coastal fauna would of the same type as those of the Proposed Action.

The cumulative impacts on terrestrial and coastal fauna of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities within the geographic analysis area would be of the types described in the Draft EIS Section 3.3.1.3, but the impacts may differ in intensity and extent. The Proposed Action would directly result in negligible to moderate amounts of terrestrial habitat loss, depending on the onshore route selected, and minor impacts on terrestrial animals through mortality and temporary displacement. The cumulative impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities within the geographic analysis area are listed by IPF in Table 3.1-1. The most impactful IPFs are anticipated to be land disturbance and climate change.

Land disturbance: Because the onshore Project Area has been heavily developed for decades, habitat quality in the vicinity, and therefore the potential suitability for use by native fauna, has been degraded. Past activities have been taken into consideration in defining the baseline conditions of the resource (Table 3.1-1). The minor to moderate impacts of the Proposed Action on terrestrial and coastal fauna (displacement, mortality, habitat loss) would be cumulative with the impacts of ongoing and future land disturbance. The future extent of land disturbance from ongoing activities and future non-offshore wind activities over the next 30 years is not known with as much certainty as the extent of land disturbance that would be caused by the Proposed Action, but, based on regional trends, is anticipated to be similar to or greater than that of the Proposed Action. Land disturbance from the Proposed Action, ongoing activities, and future non-offshore wind activities may result in erosion and sedimentation, but not likely to a degree that would result in a cumulative impact on terrestrial and coastal fauna. If future offshore wind activities other than the Proposed Action were to cross the terrestrial and coastal fauna geographic analysis area or even be collocated (partly or completely) within the same terrestrial ROW corridor that the Proposed Action would use, the impacts on terrestrial and costal fauna may increase, although the location and timing of future activities could influence the impacts. For example, repeated construction in a single ROW corridor would be expected to have less impact (e.g., displacement, mortality, habitat loss) on terrestrial and coastal fauna than construction in an equivalent area of undisturbed habitat.

Cumulative impacts from onshore construction are anticipated to include periodic temporary disturbance and displacement of mobile species and direct injury or mortality of less-mobile species.

Cumulative impacts due to onshore land use changes are expected to include a gradually increasing amount of habitat conversion and habitat loss, likely changing the composition of terrestrial faunal assemblages and possibly reducing the abundance of terrestrial fauna. One foreseeable project is a bike path extension through the Hyannis Ponds WMA (Draft EIS Section 3.3.1.3). Constructing this path would involve the clearing of a corridor through a pine-oak forest community that Massachusetts Division of Fisheries and Wildlife currently manages for the benefit of wildlife. This corridor would likely be 40 feet wide (13 meters) by approximately 1.3 miles long (2.1 kilometers), and would lead to the conversion of a 7-acre (28,328-m^2) corridor from forested habitat to forest edge habitat. The Proposed Action may collocate a portion of the onshore export cable route within this path, or, if the Proposed Action were to select another route option, this path may be built independently of the Proposed Action. The cumulative impacts on terrestrial and coastal fauna of land disturbance from the Proposed Action when combined with past, present, and reasonably foreseeable activities are anticipated to be minor to moderate.

Climate change: Climate change would contribute to cumulative impacts on terrestrial and coastal fauna, primarily due to existing global and regional climate trends. Although sources of GHG emissions contributing to regional and global climate change could occur outside the terrestrial and coastal fauna geographic analysis area, terrestrial and coastal fauna may be affected by warming, sea level rise, and altered habitat/ecology as a result. Climate change is altering the seasonal timing and patterns of species distributions and ecological relationships, likely causing permanent impacts of unknown intensity (Friggens et al. 2018). See Section A.8.1 for details on the expected contribution of offshore wind activities to climate change. The cumulative climate change impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities on terrestrial and coastal fauna are anticipated to be minor to moderate.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from minor to moderate. Considering all the IPFs, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in moderate impacts on terrestrial and coastal fauna in the geographic analysis area. The main drivers for this impact rating are ongoing and future land disturbance, ongoing climate change, and the land disturbance attributable to the Proposed Action. The Proposed Action would contribute to the overall impact rating primarily through the temporary displacement, temporary mortality, and temporary to permanent habitat loss due to construction of the onshore substation and onshore export cable. Thus, the overall cumulative impacts on terrestrial and coastal fauna would likely qualify as moderate because the measurable impacts expected would be small and/or the resource would likely recover completely when the impacting agent were gone and remedial or mitigating action were taken.

3.1.2.2. Cumulative Impacts of Alternative B

The direct and indirect impacts of Alternative B on terrestrial and coastal fauna are described in Draft EIS Section 3.3.1.4. Alternative B would likely result in similar incremental impacts as the Proposed Action, but a lesser total amount of habitat alteration compared to the maximum-case scenario under the Proposed Action, due to the avoidance of the Hyannis Ponds WMA. Under Alternative B, the maximum area affected by onshore construction of the proposed Project would be approximately 7.8 acres (31,565 m^2) along a 1.6-mile-long (2.6-kilometer) corridor. No construction would occur within the Hyannis Ponds WMA. In addition, this route does not pass near wetlands and streams, so there would be no risk of sedimentation or other impacts on these types of resources. Alternative B would result in the same amount of tree clearing for the proposed substation site as under the Proposed Action. Overall, the direct and indirect impacts of Alternative B on terrestrial and coastal fauna through land disturbance are expected to be moderate.

Similar to the situation under the Proposed Action, the cumulative impacts of Alternative B when combined with past, present, and reasonably foreseeable activities would be similar to the sum of the direct and indirect impacts of Alternative B plus the impacts that would occur under the No Action Alternative. However, if the foreseeable bike path extension through the Hyannis Ponds WMA were to proceed independently of the proposed Project, the cumulative impact of habitat alteration could be greater than if the bike path and proposed Project were collocated, which could not happen under Alternative B. Therefore, the cumulative impacts of Alternative B on terrestrial and coastal fauna may be slightly less than or slightly more than the cumulative impacts of the Proposed Action. In any case, the overall cumulative impacts of Alternative B when combined with past, present, and reasonably foreseeable activities on terrestrial and coastal fauna would be of the same level as under the Proposed Action—moderate. The main drivers for this impact rating are ongoing land disturbance, ongoing climate change, the future land disturbance associated with the potential bike path, and the land disturbance attributable to Alternative B.

3.1.2.3. Cumulative Impacts of Alternatives C, D1, D2, E, and F

As discussed in Draft EIS Sections 3.3.1.5, the direct and indirect impacts on terrestrial and coastal fauna of Alternatives C, D, or E would be practically identical to those under the Proposed Action because offshore components of the proposed Project have no potential impacts on terrestrial and coastal fauna. For the same reason, the direct and indirect impacts of Alternative F on terrestrial and coastal fauna would be practically identical to those under the Proposed Action as well. Overall, the direct and indirect impacts resulting from individual IPFs associated with Alternatives C, D, E, and F on terrestrial and coastal fauna through land disturbance are expected to be moderate. For the same reason, the overall cumulative impacts of Alternatives C, D, E, and F when combined with past, present, and reasonably foreseeable activities on terrestrial and coastal fauna would be practically identical to those under the Proposed Action and would likely qualify as moderate.

3.1.2.4. Comparison of Alternatives

As discussed in the Draft EIS Section 3.3.1.7, the direct and indirect impacts of Alternatives C, D, or E would be practically identical to those of the Proposed Action (moderate) because offshore components have no potential impact on terrestrial and coastal fauna. For the same reason, the direct and indirect impacts of Alternative F on terrestrial and coastal fauna would also be practically identical to those under the Proposed Action. Only Alternative B differs from the Proposed Action in terms of incremental impacts. Alternative B would limit the flexibility of the PDE and would use an OECR that is shorter by approximately 0.6 mile (0.9 kilometer) and would disturb approximately 2 acres (8,094 m^2) less of land surface compared to the maximum-case scenario within the Proposed Action. Alternative B would avoid approaching high-quality habitat within the Hyannis Ponds WMA, wetland, and stream, which the eastern OECR under the Proposed Action could potentially affect. Direct and indirect impacts under Alternative B would be less than those under the maximum-case scenario within the Proposed Action, and would likely still qualify as moderate.

The land disturbance of the Proposed Action or action alternatives when combined with past, present, or reasonably foreseeable activities could result in cumulative impacts. Ongoing climate change would also contribute to cumulative impacts on terrestrial and coastal fauna. As discussed in Draft EIS Section 3.3.1.8, the cumulative impacts of any action alternative would likely be slightly greater than the incremental impacts of any alternative alone, and would likely be moderate. Future offshore wind activities other than the Proposed Action may be responsible for a portion of the cumulative impacts on terrestrial and coastal fauna if any future offshore wind activities were to overlap the geographic analysis area for terrestrial and coastal fauna. Compared to the Proposed Action, Alternative B would likely result in slightly less cumulative impact on terrestrial and coastal fauna, but could result in slightly more cumulative impact than under the Proposed Action, depending on whether the foreseeable future bike path extension through the Hyannis Ponds WMA is constructed independently of the proposed Project or is collocated with the proposed Project, the latter of which could only happen under the Proposed Action. In any case, these impacts would still qualify as moderate. BOEM expects that Alternatives C, D, E, and F when combined with past, present, and reasonably foreseeable activities would have cumulative impacts that would be practically the same as those under the Proposed Action, and would likely be moderate.

3.2. COASTAL HABITATS

3.2.1. No Action Alternative Impacts

Table 3.2-1 contains a detailed summary of baseline conditions and the impacts of ongoing and future offshore activities other than offshore wind on coastal habitats in the geographic analysis area, based on the IPFs assessed. This information comes primarily from the Draft EIS, supplemented by additional information from the National Oceanic and Atmospheric Administration (NOAA) and other sources consulted in the course of responding to comments on the Draft EIS. The impact analysis is limited to impacts within the geographic analysis area for coastal habitats as described in Table A-1 and shown on Figure A.7-2 in Appendix A. This includes all lands and waters within the 3-nautical-mile seaward limit of Massachusetts' territorial sea to 100 feet (30.5 meters) landward of the first major land transportation route encountered (a road, highway, rail line, etc.) that is within a 1-mile (1.6-kilometer) buffer of the OECC.

Coastal habitats in the geographic analysis area are mostly relatively stable, although there is variability across space and time. Sand waves are mobile over the course of days to years. Eelgrass habitats in this region are in decline, with a loss of over

20 percent from 1994 to 2011 (Costello and Kenworthy 2011). Sandy beaches in these areas are subject to erosion and are vulnerable to the effects of projected climate change and relative sea level rise (Roberts et al. 2015). The shoreline is partially developed with groins, jetties, seawalls, residences, and light commercial establishments, and this development is likely to continue. Coastal habitats are subject to pressure from ongoing activities, especially those that involve anchoring, seabed profile alterations, sediment deposition and burial, gear utilized for bottom trawling and dredge fishing, and climate change. As discussed in the Draft EIS Section 3.3.4.1, the greatest concerns regarding potential impacts on coastal habitats are potential impacts on special, sensitive, and unique (SSU) habitats, especially living bottom, hard/complex bottom, eelgrass (*Zostera marina*) beds, and marine mammal habitats.

Vessel anchoring affects coastal habitats in the immediate area where anchors and chains meet the seafloor. Dredging for navigation, marine minerals extraction, and/or military uses disturbs swaths of seafloor habitat, leading to seabed profile alterations and sediment deposition in coastal habitats. Gear utilized for bottom trawling and dredge fishing results in seabed disturbances that are much more frequent and greater in spatial extent than those caused by other bottom-directed IPFs such as pipeline trenching, submarine cable emplacement, or sediment dredging. Climate change, including ocean acidification and ocean warming and sea-level rise, also affects coastal habitats. All of these ongoing impacts will continue regardless of the offshore wind industry.

Under the No Action Alternative, the proposed Project would not be built and hence would have no impact on coastal habitats. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. Considering the limited extent of the geographic analysis area for coastal habitats, only a small subset of potential future offshore wind activities have the potential to influence conditions within the analysis area. Specifically, no RI or MA Lease Areas would overlap the coastal habitat geographic analysis area, and, given the locations of RI and MA Lease Areas and the COPs or other announced plans for offshore export cable routes, the only future offshore wind activities (other than the Proposed Action) that may reasonably be expected to lay cable in the geographic analysis area are Vineyard Wind 2 (OCS-A 0501 [southern portion]), Mayflower Wind (OCS-A 0521), a development by Equinor Wind US (OCS-A 0520), and Bay State Wind (OCS-A 0500). Of these, only Vineyard Wind 2 and Mayflower Wind have announced plans for cable routes in the geographic analysis area for coastal habitats. Vineyard Wind 2 would lay cable within the same offshore export cable corridor (OECC) as the Proposed Action, and Mayflower Wind would lay cable somewhere between Martha's Vineyard and Muskeget Island, through Nantucket Sound, making landfall somewhere on Cape Cod. Because precise cable corridors are not known for any specific project other than Vineyard Wind 2, the potential impacts of future offshore wind activities (other than the Proposed Action) on coastal habitats are not reasonably quantifiable. A detailed analysis of impacts associated with future offshore wind development is provided in Section 3.2.1.1 and summarized in Table 3.2-1. Cumulative impacts of the Proposed Action and action alternatives are analyzed in Section 3.2.2.

3.2.1.1. Future Offshore Wind Activities (without Proposed Action)

BOEM expects these future offshore wind development activities would affect coastal habitat through the following primary IPFs.

Accidental releases: Accidental releases may increase as a result of future offshore wind activities. Section A.8.2 discusses the nature of releases anticipated. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities. Accidental releases of fuel/fluids/hazmat have the potential to cause contamination of habitats and harm to the species that build biogenic coastal habitats (e.g., eelgrass, oysters, mussels, slipper limpets [*Crepidula fornicata*], salt marsh cordgrass [*Spartina alterniflora*]), either from the releases themselves and/or cleanup activities. The greatest risk of accidental releases in coastal habitats would be related to transportation of crews and equipment during construction and operations, as well as accidental releases from any nearshore activities associated with transmission cable installation. Accidental releases from offshore structures and offshore vessels would likely not reach coastal habitats. Onshore, the use of heavy equipment could result in releases of fuel and lubricating and hydraulic oils during equipment use or refueling.

Trash and debris may be released by vessels during construction, operations, and decommissioning. BOEM assumes all vessels will comply with laws and regulations to minimize releases. In the event of a release it would be an accidental, small event in the vicinity of work areas. There does not appear to be evidence that the volumes and spatial and temporal extent of accidental releases of trash and debris would have any cumulative impact on coastal habitats.

The overall impacts of accidental releases on coastal habitats are likely to be localized and short-term and to result in little change to coastal habitats. As such, accidental releases from future offshore wind development would not be expected to appreciably contribute to overall impacts on coastal habitats.

Anchoring: Increased anchoring may occur in the geographic analysis area for coastal habitats during survey activities and during the construction and installation of offshore export cables. The resulting impacts on coastal habitats would include temporarily increased turbidity levels and the potential for direct contact to cause physical damage to coastal habitats. Anchors could topple boulder piles and spread them out into small boulder fields with less vertical relief and structural complexity than existed before. Anchoring in eelgrass could kill or uproot patches of eelgrass, which may require years to recover. All impacts would be localized; turbidity would be temporary; physical damage could be long-term to permanent if it occurs in eelgrass beds or hard bottom.

EMF: EMF would emanate from any operating transmission cables in the geographic analysis area for coastal habitats. Sections 3.3 and 3.4 discuss the nature of potential effects. Submarine power cables in the geographic analysis area for coastal habitats are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF resulting from cable operation to low levels. EMF of any two sources would not overlap, because developers typically allow at least 33 feet (100 meters) spacing between cables. EMF strength diminishes rapidly with distance, and potentially meaningful EMFs would likely extend less than 50 feet (15.2 meters) from each cable. Any impacts of EMF on coastal habitats would likely be undetectable.

Light: Light from vessels transiting between berths in coastal locations to/from nearshore and offshore work locations or from vessels installing cables, if any, in the geographic analysis area for coastal habitats could occur primarily during construction, but also during operations and decommissioning. Light may also emanate from onshore structures associated with offshore wind projects (e.g., operations and maintenance facilities). Sections 3.3 and 3.4 discuss the nature of potential impacts. The extent of impacts would be limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats would likely be undetectable.

New cable emplacement and maintenance: New offshore submarine cables could cause short-term disturbance of seafloor habitats if one or more cable routes enter(s) the geographic analysis area for coastal habitats. If cable routes intersect eelgrass or hard-bottom habitats, impacts may be long-term to permanent. Cable emplacement involves intense temporary disturbance of seafloor habitats during cable burial in an approximately 6.6-foot (2-meter) wide path along the entire cable route. Assuming future projects use installation procedures similar to those proposed in the Vineyard Wind COP (Epsilon 2020a), coastal habitats would recover following disturbance, except in hard-bottom habitat, which may be permanently altered. New cable emplacement and maintenance may affect coastal habitats multiple times, as different projects may install cable in consecutive or nonconsecutive years and maintenance may be required at any time. Any dredging necessary prior to cable installation could also contribute additional impacts, especially to eelgrass beds and hard-bottom habitats.

Noise: Noise from offshore wind construction activities, including pile driving, is not expected to be noticeable within the geographic analysis area for coastal habitats, given the distance of all foreseeable projects from the geographic analysis area, but noise from trenching of export cables and from geological and geophysical (G&G) surveys could reach the geographic analysis area for coastal habitats. The impacts of trenching noise or of noise from other methods of cable burial are temporary and typically less prominent than the impacts of the physical disturbance and sediment suspension. Noise from G&G surveys of cable routes may also enter the geographic analysis area intermittently over an assumed 4-year construction period. G&G noise resulting from offshore wind site characterization surveys is less intense than G&G noise from seismic surveys used in oil and gas exploration; while seismic surveys create high-intensity impulsive noise to penetrate deep into the seabed, offshore wind site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves more similar to common deep-water echosounders. Noise is anticipated to occur intermittently over an assumed 4-year construction period in the geographic analysis area. The intensity and extent of the resulting impacts on coastal habitats are difficult to generalize, but would likely be local and temporary. Overall, noise is not anticipated to cause any meaningful change to coastal habitats.

Presence of structures: Any new cable installed in the geographic analysis area for coastal habitats would likely require hard protection atop portions of the route, potentially converting previously existing habitat (whether hard-bottom or soft-bottom) to a type of hard habitat, although it differs from the typical hard-bottom habitat in the geographic analysis area, namely, coarse substrates in a sand matrix. The new habitat may or may not function similarly to hard-bottom habitat typical in the region (Kerckhof et al 2019; HDR 2019). Soft bottom is the dominant habitat type on the OCS, and structures do not meaningfully reduce the amount of soft-bottom habitat available (Guida et al. 2017; Greene et al. 2010). Structures can also create an artificial reef effect, attracting a different community of organisms. Cable protection is anticipated to be added incrementally over an assumed 4-year construction period in the geographic analysis area for coastal habitats. These changes would persist as long as the structures remain. Where cables would be buried deeply enough that protection would not be used, presence of the cable would have no impact on coastal habitats.

Land disturbance: Cable landfall sites that may be sited within the geographic analysis area for coastal habitats could contribute to erosion and sedimentation during construction. The staggered nature of construction activities would limit the total erosion and sedimentation contribution at any given time, allowing coastal habitats to recover between events. Cable landfall sites and/or onshore transmission routes within the geographic analysis area for coastal habitats could cause localized degradation of onshore coastal habitats during onshore construction, although much of the shoreline is already developed, limiting the value of habitat there. Such an effect could also involve land use changes that permanently convert onshore coastal habitats to developed space.

Seabed profile alterations: If dredging is used in the course of cable installation within the geographic analysis area for coastal habitats, localized, short-term impacts on coastal habitats would result. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance. Furthermore, sand waves in the geographic analysis area naturally move across the seafloor throughout the year. Therefore, such impacts, while locally intense, would be short-term and would have little impact on the general character of coastal habitats.

Sediment deposition and burial: Dredged material disposal that may occur in the geographic analysis area for coastal habitats could cause temporary, localized turbidity increases and long-term sedimentation or burial at the immediate disposal site; however, dredged material disposal is usually not permitted in SSU habitats, and it would therefore likely have little effect on coastal habitats. Cable installation and maintenance activities in or near the geographic analysis area during construction or maintenance of future offshore wind projects could also cause sediment suspension and re-deposition. These impacts would likely be undetectable in habitats other than hard bottom, and in hard-bottom habitats, the impacts would likely be small and short-term to long-term. Sediment deposition from simultaneous or sequential activities would likely not be interactive.

Climate change: 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 carbon dioxide (CO_2) may contribute to reduced growth or the decline of reefs and other habitats formed by shells. Section A.8.1 has details on the expected contribution of offshore wind activities to climate change.

3.2.1.2. Conclusions

Conditions of coastal habitats in the geographic analysis area for coastal habitats are mostly relatively stable, but variable across space and time. Eelgrass habitats are in decline, with a loss of over 20 percent from 1994 to 2011 (Costello and Kenworthy 2011). Sandy beaches in the region are subject to erosion and are vulnerable to the effects of projected climate change and relative sea level rise (Roberts et al. 2015). Coastal habitats at and landward of the shoreline are partially developed with groins, jetties, seawalls, residences, and light commercial establishments, and this development is likely to continue. The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impacts on coastal habitats. BOEM expects these ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing temporary to permanent impacts on coastal habitats primarily through anchoring, new cable emplacement/maintenance, noise, the presence of structures, land disturbance, seabed profile alterations, sediment deposition and burial, and climate change.

Considering all the IPFs together, BOEM anticipates that the impacts associated with the future offshore wind activities in the geographic analysis area would include both beneficial and adverse impacts, resulting in a net **negligible** impact overall. Although future offshore wind activities are expected to contribute to most of the aforementioned IPFs, the impacts of the future offshore wind activities other than the proposed Project would be difficult to distinguish from the impacts of ongoing activities and future non-offshore wind activities. BOEM expects that ongoing impacts resulting from sediment dredging, dredge fishing and bottom trawling, and land disturbance would continue to be the most impactful IPFs influencing the condition of coastal habitats in the geographic analysis area for coastal habitats.

Under the No Action Alternative, coastal habitats would continue to follow current regional trends and respond to current and future environmental and societal activities. The No Action Alternative would forgo the benthic monitoring that Vineyard Wind has committed to voluntarily perform (COP Appendix III-D; Epsilon 2020a and Epsilon 2020b), the results of which could provide an understanding of the effects of offshore wind development, benefit future management of coastal habitats, and inform planning of other offshore developments; however, other ongoing and future surveys could still provide similar data to support similar goals.

3.2.2. Proposed Action and Action Alternatives

3.2.2.1. Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on coastal habitats were described in the Draft EIS Section 3.3.4.3, and additional information is included in Table 3.2-1. The Proposed Action would likely result in impacts that are expected to be local and to not alter the overall character of coastal habitats in the geographic analysis area. Cable installation, including pre-lay dredging of sand waves, could have noticeable temporary impacts. The creation of hard-bottom habitat atop the offshore export cable would cause a permanent (for the life of the Proposed Action), possibly beneficial, impact. The potential impacts would partially depend on which offshore export cable route and landfall method were chosen, so this analysis assumes the maximum-case scenario. Considering the likely balance of potential beneficial and potential adverse changes, the Proposed Action would likely result in net **negligible** impacts on coastal habitats, from impacts possibly resulting in **negligible** to **minor beneficial** and **negligible** to **moderate** impacts as a result of individual IPFs.

The Proposed Action would contribute to impacts through all of the IPFs named in Section 3.2.1.1 except for light from structures, noise from construction or trenching, and land disturbance through onshore construction or land use change. Within the geographic analysis area for coastal habitats, the Proposed Action would not generate any light from structures or noise from construction or trenching, nor would it cause land disturbance through onshore construction or land use change. The most impactful IPFs from the Proposed Action would likely include anchoring, new cable emplacement/maintenance, and the presence of structures. Other IPFs would likely contribute impacts of lesser intensity and extent, and would occur primarily during construction, but also during operations and decommissioning (Table 3.2-1).

Three IPFs in Table 3.2-1 were not discussed previously in the Draft EIS sections regarding coastal habitats. Impacts from EMF were discussed only in Draft EIS Section 3.3.5.3. Subsequent to the publication of the Draft EIS, BOEM decided to specifically assess the potential impacts of EMF on coastal habitats. Considering the proposed cable burial depth and shielding, the extent of EMF would likely be less than 50 feet (15.2 meters) from the cable(s), and the intensity of impacts on coastal habitats would likely be **negligible**.

The Draft EIS also did not contemplate light as an IPF affecting coastal habitats. The Proposed Action would not result in new lighted structures within the geographic analysis area for coastal habitats. The Proposed Action would allow nighttime work only on an as-needed basis, in which case the proposed Project would reduce lighting of vessels, so light from vessels would also be minimal. Therefore, light resulting from the Proposed Action would likely lead to **negligible** impacts, if any, on coastal habitats.

The Draft EIS also did not consider noise as an IPF affecting coastal habitats. Noise from trenching of export cables may occur during construction, although most of the export cables would be installed using a trenchless jet-plowing method. Trenching noise would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension. Noise from trenching would likely have **negligible** impacts on coastal habitats. The Proposed Action would emit noise from G&G surveys used to inspect the cables after installation. G&G noise resulting from cable route surveys is anticipated to cause temporary, **negligible** impacts in the immediate vicinity of the cable routes.

Changes to the design capacity of the WTG proposed in the Vineyard Wind COP (Epsilon 2020a), as compared to the WTGs evaluated in the Draft EIS, would not alter the potential impacts on coastal habitats for the Proposed Action and all other action alternatives because the WDA is offshore and not within the coastal habitats geographic analysis area. Changes to the design of the onshore substation would also not alter the potential impacts on coastal habitats for the Proposed Action and all other action alternatives because the substation site is inland and would have no impact on coastal habitats.

The cumulative impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are listed by IPF in Table 3.2-1. The nature of the primary IPFs and of potential impacts on coastal habitats is described in detail in Section 3.2.1. Under the No Action Alternative, BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing temporary to permanent impacts on coastal habitats primarily through anchoring, new cable emplacement/maintenance, noise, the presence of structures, land disturbance, seabed profile alterations, sediment deposition and burial, and climate change.

The cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities would be of similar types to those described in Section 3.2.1, but may differ in intensity and extent. Considering the highly restricted cumulative impacts geographic analysis area for coastal habitats, a large fraction of the cumulative impacts on coastal habitats are expected to result from the incremental impacts of the Proposed Action, as described in the Draft EIS Sections 3.3.4.3 and 3.3.4.8.

Accidental releases: The minor incremental impact of the Proposed Action would slightly increase the risk of accidental releases beyond that under the No Action Alternative. Table A-8 in Appendix A provides a quantitative analysis of these risks. Cumulatively, the impacts on coastal habitats (contamination) from this IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be localized, temporary, and minor due to the likely limited extent and duration of a release, described in detail in Draft EIS Section 3.2.2.3. Accidental releases that are limited to trash and debris are not likely to have any detectable impact on coastal habitats within the geographic analysis area.

Anchoring: The minor to moderate incremental impact of anchoring under the Proposed Action would disturb up to 4.4 acres (17,806 m^2) (some of which would occur outside the geographic analysis area for coastal habitats, that is, offshore of the 3-nautical-mile seaward limit defining coastal habitats) (Epsilon 2018c), resulting in temporary to short-term impacts on coastal habitats. Cumulatively, anchoring impacts on coastal habitats associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be minor to moderate, localized, and temporary, but could be permanent if they occur in eelgrass beds or boulder piles.

EMF: The negligible incremental impact of the Proposed Action would slightly increase EMF in the geographic analysis area for coastal habitats beyond the EMF that would occur under the No Action Alternative, which would likely have undetectable impacts on coastal habitats. Considering the anticipated cable burial depths and shielding, meaningful EMF are expected to extend less than 50 feet (15.2 meters) from each cable; given that it is highly unlikely that any two cables would be this close together, no location within coastal habitats would be subject to overlapping EMF. The cumulative impacts of EMF on coastal habitats associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities within the geographic analysis area would likely be negligible.

Light: Light from vessels under the Proposed Action would likely lead to negligible incremental impacts, if any, on coastal habitats in addition to the light from vessels under the No Action Alternative, which would likely result in undetectable impacts on coastal habitats. The Proposed Action would not emit light from structures within the geographic analysis area for coastal habitats, and therefore no cumulative impacts from this sub-IPF on coastal habitats can be attributed to the proposed Project, although light from existing structures and future offshore wind-related structures onshore or nearshore may reach coastal habitats near shore. Overall, the cumulative impacts on coastal habitats from light within the geographic analysis area associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be negligible.

New cable emplacement and maintenance: The minor to moderate incremental impact of the Proposed Action would disturb up to an estimated 117 acres (0.5 km^2) of sea floor within the OECC during cable installation (although some of these areas would lie outside of the geographic analysis area for coastal habitats) which would be in addition to the disturbance caused by cable emplacement and maintenance under the No Action Alternative. The direct disturbance from installation of any two cables would not overlap, even within a single OECC, but see below regarding sediment deposition and burial. Cumulative impacts of this IPF on coastal habitats associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be minor to moderate, local, short-term to permanent disturbances of seafloor habitats. Section 3.3 includes a more complete description of seafloor impacts from cable placement.

Noise: The Proposed Action would have a negligible incremental impact on coastal habitats through noise related to G&G activities and trenching, likely leading to small, localized, temporary impacts in the immediate area of the activities. No cumulative impacts on coastal habitats of noise from construction or pile driving can be attributed to the Proposed Action, although ongoing activities are expected to result in local temporary impacts. Overall, the cumulative impacts on coastal habitats of noise associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be negligible, with the possible exception of pile-driving noise from ongoing activities that occur periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded.

Presence of structures: The Proposed Action is expected to cause local, negligible or minor beneficial impacts on coastal habitats through this IPF where cable protection is placed in up to 35 acres (0.1 km^2) within the OECC (although some of this would occur outside the geographic analysis area for coastal habitats) in addition to the impacts that would occur under the No Action Alternative, which would have an unknown extent, but would likely be similar to that of the Proposed Action. Cumulatively, this IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities is anticipated to cause local, permanent (as long as the structures remain), negligible or minor beneficial impacts on coastal habitats. These impacts may benefit some communities that depend on hard habitat, although the habitats that existed previously would no longer exist at the affected locations.

Land disturbance: The Proposed Action may cause local, temporary, negligible impacts on coastal habitats through erosion and sedimentation at the landfall site in addition to the impacts of land disturbance on coastal habitats under the No Action Alternative, which would likely consist of a series of local, short-term to permanent impacts from onshore construction, onshore land use changes, and erosion and sedimentation. The land disturbance-related impacts of the Proposed Action and reasonably foreseeable activities in the geographic analysis area for coastal habitats would be difficult to distinguish from the impacts of ongoing activities. Cumulatively, land disturbance via onshore construction and onshore land use changes associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities is expected to contribute to short-term to permanent degradation of portions of the existing coastal habitat at and landward of the shoreline, resulting in moderate cumulative impacts on coastal habitats.

Seabed profile alterations: The Proposed Action could dredge up to 69 acres (0.3 km^2) of seafloor beyond the area affected by cable emplacement (although some of this would occur outside of the geographic analysis area for coastal habitats), resulting in minor incremental impacts in addition to the impacts that would occur under the No Action Alternative, which would have an unknown extent but would likely be similar to that of the Proposed Action. Dredging typically occurs only in sandy or silty habitats, which are abundant in the coastal habitats geographic analysis area and are quick to recover from disturbance. Cumulative impacts of this IPF on coastal habitats within the geographic analysis area associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are likely to be minor.

Sediment deposition and burial: The Proposed Action could cause sediment deposition on up to 2,594 acres (10.5 km^2) (although part of this area would lie outside of the geographic analysis area for coastal habitats), resulting in minor incremental impacts in addition to the impacts that would occur under the No Action Alternative, which would have an unknown extent but would likely be similar to that of the Proposed Action. Sediment deposition would have no impact on coastal habitats outside of eelgrass beds and hard-bottom habitats, where the impacts would be short-term to long-term, with intensity and duration proportional to the thickness of the sediment layer deposited. Multiple projects using the same OECC or causing sediment plumes to enter the coastal habitats geographic analysis area could cause repeated sedimentation of coastal habitats. Cumulative impacts of sediment deposition and burial on coastal habitats within the geographic analysis area associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are likely to be minor.

Climate change: This IPF would contribute to the reduced growth or decline of some types of coastal habitats, the widespread loss of shoreline habitat from rising seas and erosion, and alterations to ecological relationships. Because this IPF is a global phenomenon, the cumulative impacts on coastal habitats through this IPF would be the same as those under the Proposed Action or the No Action Alternative. The intensity of impacts on coastal habitats resulting from climate change are uncertain, but are anticipated to be minor to moderate.

Other considerations: For temporary impacts, including the effects of noise, light, and thin layers of sediment deposition, it is likely that a portion, possibly the majority, of such impacts from future activities would not overlap in time with the temporary impacts of the Proposed Action. However, some IPFs (e.g., sediment deposition) that can cause temporary impacts can also cause long-term impacts.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from negligible to moderate and minor beneficial. Cumulative impacts are expected to be strongly dependent on the impacts of ongoing activities and the Proposed Action rather than future offshore wind projects, due to the limited geographic analysis area for coastal habitats. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in moderate impacts on coastal habitats in the geographic analysis area. The main drivers for this impact rating are ongoing activities such as climate change, shoreline stabilization/hardening for other human uses, and fishing impacts from bottom-tending gear. The Proposed Action would contribute to the overall impact rating primarily through the temporary disturbance due to new cable emplacement, which may temporarily increase the impact rating from minor to moderate; the permanent impacts from cable protection measures are not anticipated to modify the level of overall cumulative impacts. Thus, the overall cumulative impacts on coastal habitats would likely qualify as moderate because the measurable impacts expected would be small and/or the resource would likely recover completely when the impacting agent were gone and remedial or mitigating action were taken.

3.2.2.2. Cumulative Impacts of Alternatives B, C, D1, D2, and E

The direct and indirect impacts of Alternative B, C, D, or E on coastal habitats are described in Draft EIS Section 3.3.4. The impacts under Alternative B, C, D, or E would differ from those under the Proposed Action only in the incremental (direct and indirect) impacts of the proposed Project; the cumulative impact contributions from past, present, and reasonably foreseeable activities would be the same under any alternative. The direct and indirect impacts of Alternative B would be similar to, but slightly less than, those of the Proposed Action, and would affect slightly different coastal habitat types at the shorelines and in the final approach of the OECC (Draft EIS Section 3.3.4.1). The direct and indirect impacts resulting from individual IPFs under Alternative C, D, or E would be very similar to those of the Proposed Action because Alternatives C, D, and E differ from the Proposed Action only with respect to elements inside the WDA, which is not within the geographic analysis area for coastal habitats. Overall, the direct and indirect impacts of Alternative B, C, D, or E on coastal habitats would be similar to the Proposed Action and would likely result in net negligible impacts, including minor beneficial and moderate impacts.

While Alternative B may be slightly less impactful to coastal habitats than the Proposed Action, the cumulative impacts of Alternative B, C, D, or E when combined with past, present, and reasonably foreseeable activities would be similar to the cumulative impacts under the Proposed Action (with individual IPFs leading to impacts ranging from negligible to moderate impacts and minor beneficial impacts). The overall cumulative impacts of Alternative B, C, D, or E when combined with past, present, and reasonably foreseeable activities on coastal habitats within the geographic analysis area would be of the same level as under the Proposed Action—moderate. This impact rating is driven mostly by ongoing activities such as climate change, shoreline stabilization/hardening for other human uses, and fishing impacts from bottom-tending gear, with lesser contributions from the proposed Project's new cable emplacement and cable protection measures.

3.2.2.3. Direct, Indirect, and Cumulative Impacts of Alternative F

Alternative F would involve a new configuration of elements within the WDA. Because the WDA is not within the geographic analysis area for coastal habitats, the direct and indirect impacts of Alternative F on coastal habitats would be very similar to those of the Proposed Action, net negligible impacts, including minor beneficial and/or moderate impacts. For the same reason, in considering the cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities would be very similar to those of the Proposed Action (moderate). Changes to the design capacity of the WTG would not alter the potential impacts on coastal habitats because the WDA is offshore and does not overlap with coastal habitats. Changes to the design of the onshore substation would also not alter the potential impacts on coastal habitats because the substation site is inland and would have no impact on coastal habitats.

3.2.2.4. Comparison of Alternatives

As discussed in the Draft EIS Section 3.3.4.7, the OECC would be approximately 4.8 miles (7.8 kilometers) shorter than under the maximum-case scenario under the Proposed Action, and would affect approximately 26 acres (40,469 m^2) less of coastal habitats; furthermore, the use of horizontal directional drilling would avoid impacts on coastal habitats at and above the shoreline. That said, the direct and indirect impacts of Alternative B on coastal habitats would likely still be of the same general level as those of the Proposed Action, and would likely be net negligible impacts, including minor beneficial and moderate impacts. Alternatives C, D, E, and F are very similar, if not identical, to the Proposed Action with respect to their potential impacts on coastal habitats.

The cumulative impacts on coastal habitats of any action alternative when combined with past, present, and reasonably foreseeable activities would likely be moderate. Cumulative impacts from new cable emplacement and maintenance, sediment deposition and burial, and anchoring would likely be temporary. Recovery of coastal habitats from initial impacts may overlap in time with new impacts, especially from new cable emplacement/maintenance and anchoring. Noticeable temporary and permanent cumulative impacts are expected from onshore land disturbance and the presence of structure in the form of hard protection atop buried cables. Overall, cumulative impacts on coastal habitats would be generally similar for any action alternative for two reasons: (1) the level of cumulative impacts on coastal habitats is strongly dependent on the incremental impacts of the action alternative, and (2) the incremental impacts of any action alternative on coastal habitats would be similar. However, cumulative impacts on coastal habitats would be slightly lower under Alternative B than under the maximum-case scenario in any other action alternative because the incremental impacts of Alternative B on coastal habitats would be lower than those of the other action alternatives, although they would likely still be of the same general level. The cumulative impacts on coastal habitats of any action alternative when combined with past, present, and reasonably foreseeable activities would be greater than the impacts under the No Action Alternative.

3.3. BENTHIC RESOURCES

3.3.1. No Action Alternative Impacts

Table 3.3-1 contains a detailed summary of baseline conditions and the impacts of ongoing and future offshore activities other than offshore wind on benthic resources, based on the IPFs assessed. This information comes primarily from the Draft EIS, supplemented by additional information from NOAA, other fisheries management bodies, and other sources consulted in the course of responding to comments on the Draft EIS. The impact analysis is limited to impacts within the geographic analysis area for benthic resources as described in Table A-1 and shown on Figure A.7-3, Appendix A. Specifically, this includes a 10-mile (16.1-kilometer) radius around the WDA and the OECC proposed in the Vineyard Wind COP.

Benthic habitat in the geographic analysis area is estimated at 941,526 acres (3,810 km^2), of which 80 percent is sand, 18 percent is gravel/cobble/boulder, and 2 percent is mud/silt, according to an internal analysis of data from The Nature Conservancy (2014). Benthic faunal resources in the geographic analysis area include polychaetes, crustaceans (particularly amphipods), mollusks (gastropods and bivalves), echinoderms (e.g., sand dollars, brittle stars, and sea cucumbers), and various other groups (e.g., sea squirts and burrowing anemones) (Guida et al. 2017). The region experiences strong seasonal variations in water temperature and phytoplankton concentrations, with corresponding seasonal changes in the densities of benthic organisms. 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), and sediment dredging. Studies of the Atlantic Coast from 1990 to 2010 show endemic benthic invertebrates shifting their distribution northwards in response to rising water temperatures, resulting in changes to benthic community structure (Hale et al. 2016). Dredging for navigation, marine minerals extraction, and/or military uses, as well as commercial fishing bottom-tending gear, disturb benthic resources on a recurring basis. Effects of these activities will continue regardless of offshore wind energy development.

Under the No Action Alternative, the proposed Project would not be built and hence would have no benthic resources impact. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. The following analysis addresses reasonably foreseeable offshore wind projects (or portions of projects) that fall within the geographic analysis area and considers the assumptions included in Section 1.2 and Appendix A. The analysis assumes that state offshore wind power demand could not be accommodated entirely by projects in the geographic analysis area for benthic resources, and the analysis does not include the impacts associated with the proposed Project. The analysis is limited to reasonably foreseeable offshore wind developments for which at least 5 percent of the wind lease area overlaps the geographic analysis area, namely OCS-A 0500, OCS-A 0501, OCS-A 0520 and OCS-A 0521 (Figure A.7-3). The specific routes of unannounced OECCs are not reasonably foreseeable; therefore, the analysis does not consider any cable that would originate from a RI and MA Lease Area not listed above. A detailed analysis of impacts associated with future offshore wind development is provided in Section 3.3.1.1 and summarized in Table 3.3-1. Cumulative impacts of the Proposed Action and action alternatives are analyzed in Section 3.3.2.

3.3.1.1. Future Offshore Wind Activities (without Proposed Action)

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

Accidental releases: Accidental releases may increase as a result of future offshore wind activities. See Appendix A Section A.8.2 for a discussion of the nature of releases anticipated. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities.

Accidental releases of hazardous materials (hazmat) mostly consist of fuels, lubricating oils, and other petroleum compounds. Because most of these materials tend to float in seawater, they are unlikely to contact benthic resources. The chemicals with potential to sink or dissolve rapidly are predicted to dilute to non-toxic levels before they would reach benthic resources. In most cases, the corresponding impacts on benthic resources are unlikely to be detectable unless there is a catastrophic spill from ongoing activities (e.g., an accident involving a tanker ship).

Invasive species can be released accidentally, especially during ballast water and bilge water discharges from marine vessels. Increasing vessel traffic related to the offshore wind industry would increase the risk of accidental releases of invasive species, primarily during construction. Releases of invasive species may or may not lead to the establishment and persistence of invasive species. Although the likelihood of invasive species becoming established as a result of offshore wind activities is very low, the impacts of invasive species on benthic resources could be strongly adverse, widespread, and permanent if the species were to become established and out-compete native fauna. The increase in this risk related to the offshore wind industry would be small in comparison to the risk from ongoing activities (e.g., trans-oceanic shipping).

Accidental releases of trash and debris may occur from vessels primarily during construction, but also during operations and decommissioning. BOEM assumes all vessels would comply with laws and regulations to minimize releases. In the event of a release, it would be an accidental, localized event in the vicinity of work areas. The greatest likelihood of releases would be associated with nearshore project activities, e.g. transmission cable installation and transportation of equipment and personnel from ports. However, there does not appear to be evidence that the volumes and extents anticipated would have any detectable impact on benthic resources.

The overall impacts of accidental releases on benthic resources are likely to be localized and short-term, and to result in little change to benthic resources. As such, accidental releases from future offshore wind development would not be expected to appreciably contribute to overall impacts on benthic resources.

Anchoring: In the future offshore wind scenario, there would be increased anchoring of vessels during survey activities and during the construction, installation, maintenance, and decommissioning of offshore components. In addition, anchoring/mooring of met towers or buoys could be increased. Anchoring would cause increased turbidity levels and would have the potential for direct contact to cause mortality of benthic resources. Using the assumptions in Appendix A, anchoring could affect up to 56 acres (0.2 km^2). All impacts would be localized, turbidity would be temporary, and mortality of benthic resources from direct contact would be recovered in the short term. Degradation of sensitive habitats, such as eelgrass beds and hard bottom, if it occurs, could be long-term to permanent.

EMFs: EMFs would emanate from new operating transmission cables and existing cables connecting Nantucket and Martha's Vineyard to mainland Massachusetts. In the cumulative scenario, an estimated 943 miles (1,518 kilometers) of cable would be added in the geographic analysis area, producing EMF in the immediate vicinity of each cable during operation. 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. Wherever a cable is not buried, the exposure of benthic resources to magnetic fields may be stronger. EMF of any two sources would not overlap because developers typically allow at least 330 feet (100 meters) between cables (even for multiple cables within a single OECC), EMF strength diminishes rapidly with distance, and potentially meaningful EMFs would likely extend less than 50 feet (15.2 meters) from each cable. Some benthic species can detect EMFs, although EMFs do not appear to present a barrier to animal movement. Burrowing infauna may be exposed to stronger EMFs, but there is little information available regarding the potential consequences. For example, BOEM's search of the available literature revealed no documented long-term impacts from EMFs on clam habitat as a result of the existing power cables connecting Nantucket Island to mainland Massachusetts. In fact, there is little to no information on the EMF sensitivity of any taxa that are not commercially important (CSA Ocean Sciences, Inc. and Exponent 2019, Hutchison et al. 2018, Thomsen et al. 2015). Impacts on benthic resources would likely be undetectable, but would be permanent as long as the cables are in operation (Section 3.4.1.1).

New cable emplacement and maintenance: New offshore submarine cables associated with the expanded cumulative scenario would cause short-term disturbance of seafloor habitats and injury and mortality of benthic resources in the immediate vicinity of the cable emplacement activities. The total area of direct disturbance resulting from new cable emplacement is estimated to be up to 1,269 acres (5.1 km^2). This would be a small fraction of available habitat in the geographic analysis area. For example, assuming as a worst-case scenario that the entire disturbance was in gravel/boulder habitat, it would affect around 1 percent of that available habitat; in actuality, most of the disturbance would be expected to occur in sandy habitat and would affect less than 0.2 percent of that available habitat (according to an internal analysis of data from The Nature Conservancy 2014). Increased turbidity would occur during construction for 1 to 6 hours at a time over an assumed 7-year construction period in the geographic analysis area for benthic resources. Disturbed seafloor from construction of those projects may affect benthic resources; assuming future projects use installation procedures similar to those proposed in the COP, the duration and extent of impacts would be limited, short-term, and benthic assemblages would recover from disturbance. If routes intersect eelgrass or hard-bottom habitats, impacts may be long-term to permanent. All impacts would be localized, turbidity would be present during construction for 1 to 6 hours at a time, and mortality from direct contact would be recovered in the short term. Any necessary dredging prior to cable installation could also contribute additional impacts (see also the IPFs of seabed profile alterations and of sediment deposition and burial).

Noise: Noise from construction, pile driving, G&G survey activities, operations and maintenance, and trenching/cable burial could contribute to impacts on benthic resources. The most impactful noise is expected to result from pile driving. Noise from pile driving would occur during installation of foundations for offshore structures. This noise would be produced during construction for 4 to 6 hours at a time over an assumed 7-year construction period in the geographic analysis area. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to benthic resources in a limited area around each pile, and can cause short-term stress and behavioral changes to individuals over a greater area. The extent depends on pile size, hammer energy, and local acoustic conditions; based on estimates in the COP, the extent of behavioral impacts is likely less than 5.7 miles (9.2 kilometers) around each pile, and the extent of potential mortality is expected to cover approximately 9.7 acres (39,254 m^2) per foundation. If all 257 foundations in the reasonably foreseeable offshore wind scenario are summed, mortality is expected to cover approximately 2,493 acres (10.1 km^2); it should be noted that this area completely overlaps the estimated area of foundations and foundation scour protection. The affected areas would likely be recolonized in the short term. In the reasonably foreseeable scenario, noise from pile-driving that causes behavioral changes could affect the same populations or individuals multiple times in a year or in sequential years; it is currently unknown whether it would cause less impact on benthic faunal resources to drive many piles sequentially or concurrently.

Noise from G&G surveys of cable routes and other site characterization surveys for offshore wind facilities could also disturb benthic resources in the immediate vicinity of the investigation and can cause temporary behavioral changes. G&G noise would occur intermittently over an assumed 7-year construction period. G&G noise resulting from offshore wind site characterization surveys is less intense than G&G noise from seismic surveys used in oil and gas exploration; while seismic surveys create high-intensity impulsive noise to penetrate deep into the seabed, offshore wind site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves for shallow penetration of the seabed. Detectable impacts of G&G noise on benthic resources would rarely, if ever, overlap from multiple sources, but may overlap with behavioral impacts of pile-driving noise. Overlapping sound sources are not anticipated to result in a greater, more intense sound; rather, the louder sound prevents the softer sound from being detected.

Noise from trenching/cable burial, WTG operations and maintenance, and construction activities other than pile driving are expected to occur, but would have little impact on benthic resources. Noise from trenching of inter-array and export cables would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbances discussed under new cable emplacement/maintenance and sediment deposition and burial. Finally, while noise associated with operational WTGs may be audible to some benthic resource, 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 resources (English et al. 2017). As measured at the Block Island Wind Farm, the low-frequency noise from WTG operation barley exceeds ambient levels at 164 feet (35.4 meters) from the WTG base. Based on the results of Thomsen et al. (2015) and Kraus et al. (2016a), sound pressure levels would be expected to be at or below ambient levels at relatively short distances from WTG foundations (about 164 feet [35.4 meters]). Noise from construction activities other than pile driving may occur; however, little of that noise propagates through the water, and therefore it would not be likely to cause any detectable impact on benthic resources.

Port utilization: Increases in port utilization due to other offshore wind projects would lead to increased vessel traffic. This increase in vessel traffic would be at its peak during construction activities over a period of 7 years and would decrease during operations but increase again during decommissioning. In addition, any related port expansion and construction activities related to the additional offshore wind projects would also add to the total amount of disturbed benthic area, resulting in disturbance and mortality of individuals and temporary to permanent habitat alteration. At least one port in the geographic analysis area is contemplating expansion/modification in Vineyard Haven (Tisbury). Existing ports are heavily modified/impaired benthic environments, and future port projects would likely implement BMPs (e.g., stormwater management, turbidity curtains) to minimize impacts. Therefore, the degree of impacts on benthic resources would likely be undetectable outside the immediate vicinity of the port expansion activities.

Presence of structures: The presence of structures 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 foundations, scour/cable protection, and buoys and met towers. Using the assumptions in Appendix A, the foreseeable offshore wind scenario would include up to 257 new foundations, 219 acres (0.9 km^2) of foundation scour protection, and 250 acres (1.1 km^2) of new hard protection atop cables. In the geographic analysis area, structures are anticipated predominantly on sandy bottom, with the exception of cable protection, which is more likely to be needed where cables pass through hard bottom. Projects may also install more buoys and met towers. BOEM anticipates that structures would be added intermittently over an assumed 7-year period and that they would remain until decommissioning of each facility is complete. Although the glacial moraine and till that broadly extends from Montauk through Block Island, Nantucket, and Martha's Vineyard exhibits areas of gravel, cobble, and boulders, currently there is little in terms of large hard structure (greater than 3 feet [1 meter] high) in the geographic analysis area outside of coastal zones, so these additions would constitute a large change to the amount of large hard structure present.

The presence of structures would increase the risk of gear loss/damage by entanglement. The lost gear, moved by currents, can disturb, injure, or kill benthic resources. The intermittent impacts at any one location would likely be localized and short-term, although the risk of occurrence would persist as long as the structures and debris remain.

Manmade structures, especially tall vertical structures such as foundations, alter local water flow (hydrodynamics) at a fine scale (Section 3.4.1.1). The consequences for benthic resources of such hydrodynamic disturbances are anticipated to be undetectable to small, to be localized, and to vary seasonally.

Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. Structure-oriented fishes would be attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes could adversely affect benthic communities in the immediate vicinity of the structure. These impacts are expected to be local and to be permanent as long as the structures remain.

The presence of structures would also result in new hard surfaces that could provide new habitat for hard-bottom species like blue mussels and sea anemones, as seen at the Block Island Wind Farm (Kerckhof et al. 2019; HDR 2019). However, the new surfaces could also be colonized by invasive species (e.g., certain tunicate species) found in hard-bottom habitats on Georges Bank (Frady and Mecray 2004). Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). The potential effects of wind farms on offshore ecosystem functioning has been studied using simulations calibrated with field observations (Raoux et al. 2017; Pezy et al. 2018;

Wang et al. 2019). These studies found increased biomass for benthic fish and invertebrates. This indicates that offshore wind farms can generate some positive impacts on local ecosystems. However, some impacts such as the loss of soft-bottom habitat may be adverse. In light of the above information, BOEM anticipates that the impacts associated with the presence of structures may be slightly adverse to slightly beneficial. The impacts on benthic resources resulting from the presence of structures would be permanent as long as the structures remain.

Discharges: There would be increased potential for discharges from vessels during construction, operations, and decommissioning. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. There would be an increase in discharges, particularly during construction and decommissioning, and the discharges would be staggered over time and localized. There does not appear to be evidence that the volumes and extents anticipated would have any overall impact on benthic resources.

Regulated fishing effort: Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by Massachusetts, towns, and/or NOAA, depending on jurisdiction, affect benthic resources by modifying the nature, distribution and intensity of fishing-related impacts, including those that disturb the seafloor (trawling, dredge fishing). Offshore wind development could indirectly influence this, possibly indirectly influencing when, where, and to what degree fishing activities affect benthic resources (Section 3.11.1).

Seabed profile alterations: Dredging and/or mechanical trenching used in the course of cable installation can cause localized short-term impacts (habitat alteration, injury, and mortality) on benthic resources through seabed profile alterations, as well as through the sediment deposition IPF. The level of impact from seabed profile alterations could depend on the time of year that they occur, particularly in nearshore locations, especially if they overlap with times and places of high benthic organism abundance. The need for dredging depends on local seafloor conditions; assuming the areal extent of such impacts is proportional to the length of cable installed, such impacts from future offshore wind activities would likely be on the order of 3 times more than the Proposed Action alone. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance. Mechanical trenching, used in more resistant sediments (e.g., gravel, cobble), causes seabed profile alterations during use, although the seabed is typically restored to its original profile after utility line installation in the trench. Therefore, seabed profile alterations, while locally intense, have little impact on benthic resources in the geographic analysis area.

Sediment deposition and burial: Cable emplacement / maintenance activities (including dredging) in or near the geographic analysis area during construction or maintenance of future offshore wind projects could cause sediment suspension for 1 to 6 hours at a time, after which the sediment is deposited on the seafloor. The Draft EIS Section 3.3.5.3 contains details on the specific impacts, species-specific sensitivity thresholds, and estimated degree of sediment deposition caused by typical cable emplacement activities. Sediment deposition can result in adverse impacts on benthic resources, including smothering. 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. Assuming the areal extent of such impacts is proportional to the length of cable installed, such impacts from future offshore wind activities would likely be on the order of 3 times more than the Proposed Action. Increased sediment deposition may occur during multiple years. The area with a cumulatively greater sediment deposition from simultaneous or sequential activities would be limited, as most of the impacted areas would only be lightly sedimented (less than 0.04 inch [1 millimeter]) and would recover naturally in the short term. If any occurs in the geographic analysis area, dredged material disposal during construction would cause localized, temporary turbidity increases and long-term sedimentation or burial of benthic organisms at the immediate disposal site. The impacts of burial would likely be short-term to long-term.

Climate change: Benthic resources may be affected by climate change, including ocean acidification, warming and sea level rise, and altered habitat/ecology. Ocean acidification caused by atmospheric CO_2 may contribute to reduced growth or the decline of benthic resources with calcareous shells (PMEL 2020). Warming of ocean waters is expected to influence the distributions and migrations of benthic resources, and may influence the frequencies of various diseases (Hoegh-Guldberg and Bruno 2010; Brothers et al. 2016). Because this IPF is a global phenomenon, impacts on benthic resources through this IPF would be practically the same in the expanded future offshore wind scenario as they would be with only ongoing activities. See Appendix A Section A.8.1 for details on the expected contribution of offshore wind development to climate change.

3.3.1.2. Conclusions

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impacts on benthic resources. BOEM expects ongoing activities and future offshore wind activities to have continuing temporary to permanent impacts (disturbance, injury, mortality, habitat degradation, habitat conversion) on benthic resources, primarily through pile-driving noise, anchoring, new cable emplacement, the presence of structures during operations of future offshore facilities (i.e., cable protection and foundation scour protection), climate change, and ongoing seafloor disturbances caused by sediment dredging and fishing using bottom-tending gear.

Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in moderate adverse impacts and could potentially include moderate beneficial impacts. Future offshore wind activities are expected to contribute considerably to these IPFs, primarily through the presence of structures, namely foundations and scour/cable protection.

The majority of offshore structures in the geographic analysis area would be attributable to the offshore wind industry. The offshore wind industry would also be responsible for the majority of impacts related to new cable emplacement and to pile-driving noise. The total estimated area potentially subject to mortality of benthic resources from future offshore wind activities would include 2,493 acres (10.1 km^2) affected by pile-driving noise (which completely overlaps the area occupied by foundations and foundation scour protection), 250 acres (1.1 km^2) affected by hard protection atop cables, 56 acres (0.2 km^2) affected by anchoring, and 1,269 acres (5.1 km^2) directly affected by new cable emplacement, for a total of approximately 4,068 acres (16.5 km^2), most or all of which is expected to be recolonized. Benthic communities forming after disturbance may contain different species than before disturbance, although the community may still be of the same general type (HDR 2017, 2019). In either disturbed or converted habitats, ecological succession typically leads to changes in the community over time; in particular, new hard habitat related to offshore wind structures has been observed to initially exhibit high diversity but to transition to low-diversity communities dominated by blue mussels and anemones after a few years (Kerckhof et al. 2019). Hard structures may benefit benthic communities that depend on hard-bottom habitat, and would remove habitat for common communities that utilize abundant soft-bottom habitat (Section 3.4.2). BOEM expects that ongoing seafloor disturbances caused by sediment dredging and fishing utilizing bottom-tending gear would continue to cause considerable impacts on benthic resources in the geographic analysis area regardless of the offshore wind industry. However, if fishing utilizing bottom-tending gear were to occur less within WTG arrays than under existing conditions, benthic resources may indirectly benefit from this reduction in bottom disturbance, although the fishing effort may simply be transferred to different locations within or outside this geographic analysis area.

Under the No Action Alternative, benthic resources would continue to follow current regional trends and respond to current and future environmental and societal activities. The No Action Alternative would forgo the benthic resource monitoring that Vineyard Wind has committed to voluntarily perform (COP Appendix III-D; Epsilon 2020a and Epsilon 2020b), the results of which could provide an understanding of the impact of offshore wind development, benefit future management of benthic resources, and inform planning of other offshore developments; however, other ongoing and future surveys could still provide similar data to support similar goals.

3.3.2. Proposed Action and Action Alternatives

3.3.2.1. Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on benthic resources were described in the Draft EIS Section 3.3.5.3, and additional information is included in Table 3.3-1.

The Proposed Action would likely result in impacts (disturbance, injury, mortality, habitat degradation, habitat conversion) that are expected to be local and to not alter the overall character of benthic resources in the geographic analysis area. Vessel anchoring and dredging for cable installation could have noticeable temporary impacts. The presence of hard structures atop the offshore export cables and at foundations providing hard-bottom habitat would lead to a permanent (for the life of the Proposed Action), possibly beneficial, impact on some benthic assemblages (increased abundance of benthic resources that are dependent on hard surfaces) and would certainly alter the existing habitats. The potential impacts would partially depend on which offshore export cable route and landfall method were chosen, so this analysis assumes the maximum-case scenario. Some impacts would be adverse and some could be beneficial; overall, the direct and indirect impacts of the Proposed Action on benthic resources would likely be **moderate** impacts, although the presence of structure may result in **moderate beneficial** impacts in some locations.

The Proposed Action would contribute to impacts through all the IPFs named in Section 3.3.1.1 except for port utilization; the Proposed Action would not involve any port upgrades or changes in port utilization that would affect benthic resources, and the Proposed Action's use of an already upgraded and operating port facility is not expected to cause impacts on benthic resources. The most impactful IPFs from the Proposed Action would likely include the presence of structures, pile-driving noise, anchoring, new cable emplacement and maintenance, sediment deposition and burial, anchoring, and climate change. Other IPFs would likely contribute impacts of lesser intensity and extent, and would occur primarily during construction, but also during operations and decommissioning (Table 3.3-1).

Eight IPFs or sub-IPFs in Table 3.3-1 were not discussed previously in the Draft EIS sections regarding benthic resources. The first, accidental releases of trash and debris, may occur from vessels primarily during construction, but also during operations and decommissioning. BOEM assumes all vessels would comply with laws and regulations to minimize releases. In the event of a release, it would be an accidental, localized event in the vicinity of project areas. The greatest likelihood of releases would be associated with nearshore project activities, e.g. transmission cable installation and transportation of equipment and personnel from ports. However, there does not appear to be evidence that the volumes and extents would have any detectable impact on benthic resources. Therefore, the Proposed Action would likely have no impact on benthic resources through the accidental release of trash and debris. Also, accidental releases of invasive species could affect benthic resources; the risk of this type of release would be increased by the additional vessel traffic associated with the Proposed Action, especially traffic from foreign ports, primarily during construction. The potential impacts on benthic resources are described in Section 3.3.1.1. The increase in the risk of accidental releases of invasive species attributable to the Proposed Action would be **negligible**.

The Draft EIS also did not consider noise from G&G surveys, WTG operations and maintenance, pile driving, or trenching. The natures of these sub-IPFs and of their impacts on benthic resources are described in detail in Section 3.3.1.1. The Proposed Action would produce noise from pile driving during installation of up to 102 foundations for 4 to 6 hours at a time during construction. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to benthic resources in a limited area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. The estimated extent of behavioral impacts is likely less than 5.7 miles (8 kilometers) around each pile, and the extent of mortality is assumed to cover 9.7 acres (39.254 m^2) per foundation, totaling approximately 989 acres (4 km^2). The affected areas would likely be recolonized in the short term, and the overall impact on benthic resources would be **moderate**.

The Draft EIS also did not describe how the presence of structures could result in entanglement or gear loss/damage or could result in hydrodynamic disturbance. BOEM has included these sub-IPFs in response to further discussion with NOAA and public comments received on the Draft EIS. The natures of these sub-IPFs and of their impacts on benthic resources are described in detail in Section 3.3.1.1. The Proposed Action could result in up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection that could influence hydrodynamics and/or risk of entanglement or gear loss/damage in the manner discussed above.

The Draft EIS also did not describe how climate change could affect benthic resources, although it did consider this IPF in Draft EIS Section 3.3.6.10. The various impacts of this IPF on benthic resources are described in detail in Section 3.3.1.1. The impacts of climate change on benthic resources under the Proposed Action would be practically the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of the Proposed Action to climate change.

Changes to the design capacity of the turbine to be used would not alter the maximum potential impact on benthic resources for the Proposed Action and all other action alternatives because the maximum-case scenario involves the maximum number of WTGs (100) allowed in the PDE. Changes to the design of the onshore substation would also not alter the potential impacts on benthic resources for the Proposed Action and all other action alternatives because the substation site is inland and would have no impact on benthic resources.

The cumulative impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are listed by IPF in Table 3.3-1. The nature of the primary IPFs and of potential impacts on benthic resources is described in detail in Section 3.3.1.1. Under the No Action Alternative, BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing temporary to permanent impacts (disturbance, injury, mortality, habitat degradation, habitat conversion) on benthic resources, primarily through the following IPFs: pile-driving noise, anchoring, new cable emplacement, the presence of structures during operations of future wind farms (i.e., cable protection and foundation scour protection), climate change, and ongoing seafloor disturbances caused by sediment dredging and fishing utilizing bottom-tending gear.

The cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities would be of similar types as described in Sections 3.3.1.1 and 3.3.1.2, but may differ in intensity and extent. As described in the introduction to Chapter 3, BOEM assumes that the impacts to resources with “restricted” geographic analysis areas, such as benthic resources, would not be equal with or without the Proposed Action. In the absence of the Proposed Action, BOEM assumes that the total generating capacity of offshore wind facilities in geographic analysis area would be 2,655 MW, which is 800 MW less than if the Proposed Action were approved. For the most part, the incremental impacts of the Proposed Action would be additive with those of ongoing activities, future non-offshore wind activities, and other future offshore wind activities.

Accidental releases: The negligible incremental impact of the Proposed Action would constitute a very small increase in the risk of accidental releases beyond the risk under the No Action Alternative. See Appendix A Section A.8.2 (Water Quality) for a quantitative analysis of these risks. Cumulatively, the risk of impacts on benthic resources due to accidental releases of invasive species associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would qualify as major (although most of this risk comes from ongoing activities), and the cumulative impacts (mortality, decreased fitness, disease) due to other types of accidental releases are expected to be localized, temporary, and negligible.

Anchoring: Vessel anchoring would cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. Impacts on benthic resources are greatest for sensitive benthic habitats (e.g., eelgrass beds, hard bottom). The minor to moderate incremental impact of anchoring in the Proposed Action would disturb up to 4.4 acres (17,806 m^2) (Epsilon 2018c) in addition to the anchoring disturbance that would occur under the No Action Alternative, resulting in temporary to short-term impacts on benthic resources including turbidity, injury, mortality, and habitat degradation). The Proposed Action would not anchor in eelgrass. Cumulatively, anchoring could affect up to 60 acres (0.2 km^2) (although some of this may occur after the resource has recovered from the earlier impacts) associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities, resulting in minor to moderate cumulative impacts on benthic resources. All impacts would be localized; turbidity would be temporary; mortality from direct contact would be recovered in the short term. Degradation of sensitive habitats such as hard bottom, if it occurs, could be long-term.

EMFs: The negligible incremental impact of the Proposed Action would slightly increase the impacts of EMFs in the geographic analysis area beyond the EMFs that would occur under the No Action Alternative, which would likely have undetectable impacts on benthic resources. Cumulatively, the impacts on benthic resources due to EMFs associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be negligible. Wherever a cable is not buried, the exposure of benthic resources to EMFs may be stronger. As described in Section 3.3.1.1, EMFs from multiple cables would not overlap even for multiple cables within a single OECC. Furthermore, most benthic resources are primarily not mobile or move very slowly, and thus are not susceptible to multiple exposure to EMFs. In the case of mobile species, an individual exposed to EMFs would cease to be affected when it leaves the affected area. An individual may be affected more than once during long-distance movements; however, there is no information on whether previous exposure to EMFs would influence the impacts of future exposure. EMFs do not appear to constitute a barrier to migration (Section 3.4.1).

New cable emplacement and maintenance: The moderate incremental impact of the Proposed Action (disturbance, injury, and mortality), estimated to affect up to 328 acres (1.3 km^2) of seafloor within the OECC during cable installation and up to 69 acres (0.3 km^2) during additional dredging prior to cable installation, would be in addition to the impacts caused by cable emplacement and maintenance under the No Action Alternative. Although cable routes and lengths for other offshore wind projects are not known at this time, using the assumptions in Appendix A, the total seafloor disturbance from the Proposed Action and other offshore wind projects is estimated to be 1,590 acres (6.4 km^2). In most locations, the affected areas are expected to recover naturally, and impacts would be short-term because seabed scars associated with jet plow cable installation are expected to recover in a matter of weeks, allowing for rapid recolonization (MMS 2009). Mechanical trenching, which could be used in coarser sediments, could result in more intense disturbances and a greater width of the impact corridor, and is also expected to recover naturally. Other cable installation techniques would be expected to result in similar impacts. The cumulative impacts of this IPF on benthic resources (disturbance, injury, and mortality) associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are anticipated to be moderate. Any dredging necessary prior to cable installation for other offshore wind projects could also contribute additional impacts (see also the IPFs of seabed profile alterations and of sediment deposition and burial).

Noise: The negligible (for most noises) to moderate (for pile-driving noise) incremental impacts of the Proposed Action on benthic resources, likely leading to disturbance, injury, and mortality in the immediate vicinity of the activities, would be in addition to the noise that would occur under the No Action Alternative, which is expected to result in similar local temporary impacts. The most impactful noise is expected to come from pile driving. The cumulative area affected by pile-driving noise is expected to include potential injury or mortality across approximately 3,482 acres (14.1 km^2) and changes to individual behavior over a greater area. The impacts on benthic resources of pile-driving noise from any one project and the cumulative impact of pile-driving noise on benthic resources would both likely qualify as moderate. Based on the assumptions in Appendix A, no two projects in the geographic analysis area would drive piles at the same time; however, if multiple piles are driven simultaneously, the areas of potential injury or mortality would not overlap. The areas of behavioral impacts may overlap; although the noises from driving multiple piles are unlikely to overlap at any one time, individuals may be affected by noise from sequential events before they have fully recovered from previous exposures.

Port utilization: Because the Proposed Action would cause no change in port utilization, no cumulative impacts of this IPF on benthic resources can be attributed to the Proposed Action, although ongoing and future activities, including other offshore wind projects, are expected to cause impacts.

Presence of structures: The various types of impacts on benthic resources that could result from the presence of structures, such as entanglement and gear loss/damage, hydrodynamic disturbance, fish aggregation, and habitat conversion, are described in detail in Section 3.3.1.1. The incremental negligible to minor impacts (disturbance, injury, mortality, increased predation, habitat degradation and conversion) and moderate beneficial impacts (provision of hard-structure habitat) of the Proposed Action would be in addition to the impacts beyond those of the No Action Alternative. Cumulatively, using the assumptions in Appendix A, there could be up to 359 foundations, 272 acres (1.1 km^2) of scour protection, and 348 acres (1.4 km^2) of cable protection. Of this, 102 foundations, 53 acres (0.2 km^2) of scour protection and 98 acres (0.4 km^2) of cable protection would result from the Proposed Action, and the remainder is the estimated result of other offshore wind projects in the geographic analysis area. Currently, there is little in terms of large hard structure outside of coastal zones, so these additions would constitute a large change to existing conditions. The structures and the consequential impacts would remain at least until decommissioning of each facility is complete. Considering the above information, the cumulative impacts of this IPF on benthic resources associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are anticipated to include minor to moderate impacts (disturbance, injury, mortality, increased predation, habitat degradation and conversion) and moderate beneficial impacts (provision of hard-structure habitat).

Discharges: The Proposed Action is not anticipated to cause any impacts on benthic resources through this IPF. Ongoing and future non-offshore wind activities may cause short-term local impacts (disturbance, reduction in fitness) through this IPF. Future offshore wind activities are expected to cause little to no impact on benthic resources through this IPF. No cumulative impacts of this IPF on benthic resources can be attributed to the Proposed Action, although future non-offshore wind activities may cause short-term local impacts. Overall, these impacts would fall within the range of impacts from ongoing activities. Any new ocean disposal sites would not overlap the corresponding impacts of the Proposed Action. Many discharges are required to comply with permitting standards, established to ensure discharge potential impacts on the environment are mitigated. There does not appear to be evidence that the volumes and extents anticipated would have any overall impact on benthic resources.

Regulated fishing effort: Regulated fishing effort can affect benthic resources by modifying the nature, distribution, and intensity of fishing-related impacts (mortality, bottom disturbance). The Proposed Action and other future offshore wind development could indirectly influence this IPF (Section 3.11.2), possibly indirectly influencing when, where, and to what degree fishing activities affect benthic resources. See Section 3.11.2 for the cumulative contribution of ongoing, future non-offshore wind, future offshore wind, and the Proposed Action on regulated fishing effort. The intensity of impacts on benthic resources under future fishing regulations are uncertain, but would likely be similar to, or less than, under the status quo, and would likely qualify as moderate.

Seabed profile alterations: The minor incremental impacts (injury, mortality, short-term habitat disturbance) of the Proposed Action's dredging of up to 69 acres (0.3 km^2) of seafloor beyond the area affected by cable emplacement would be in addition to the seabed profile alteration impacts of the No Action Alternative. Although the amount of seabed profile alteration in the No Action Alternative is not known, it is likely to be on the order of 3 times more than the Proposed Action alone. The cumulative impacts of this IPF on benthic resources associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are likely to be widespread and minor.

Sediment deposition and burial: The minor incremental impacts of the Proposed Action (smothering, loss of fitness, short-term habitat degradation) would be in addition to the sediment deposition and burial impacts of the No Action Alternative. The Proposed Action would directly cause sediment deposition on up to 2,594 acres (10.5 km^2). Ongoing activities cause similar impacts over an unknown extent. Future offshore wind activities would also cause similar impacts over an area that is unknown but would likely be on the order of 3 times more than the Proposed Action alone. The cumulative impacts of this IPF on benthic resources associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be short-term to long-term and minor, considering that most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area.

Climate change: This IPF would contribute to alterations in ecological relationships, alterations in migration patterns, changes to disease frequency, and the reduced growth or decline of invertebrates that have calcareous shells. Because this IPF is a global phenomenon, the cumulative impacts through this IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be practically the same as those under the No Action Alternative. The intensity of impacts resulting from climate change are uncertain, but are anticipated to qualify as minor to moderate.

Other considerations: The total estimated area subject to mortality of benthic resources from future offshore wind activities including the Proposed Action would include 3,482 acres (14.1 km^2) affected by pile-driving noise, 272 acres (1.1 km^2) affected by hard protection atop cables, 60 acres (0.2 km^2) affected by anchoring, and 1,590 acres (6.4 km^2) directly affected by new cable emplacement, for a total of approximately 5,404 acres (21.9 km^2), most or all of which is expected to be recolonized. Benthic communities forming after disturbance may contain different species than before disturbance, although the community may still be of the same general type (HDR 2017, 2019). In either disturbed or new habitats, ecological succession typically leads to changes in the community over time. For temporary impacts, including the behavioral impact of pile-driving noise and the temporary habitat disturbance caused by anchoring and new cable emplacement, it is likely that a portion of such impacts from future offshore wind activities would not overlap in time with impacts of the Proposed Action. Considerable impacts on benthic resources may also occur through IPFs not caused by the Proposed Action or other offshore wind activities. Specifically, dredging and bottom trawling are expected to contribute a continuous series of short-term local impacts across much of the geographic analysis area. Although the Proposed Action would not contribute to these impacts, the impacts of the Proposed Action on benthic resources in combination with the impacts of these other activities could lead to cumulative impacts on benthic resources. One possible cumulative indirect impact of the Proposed Action and other future offshore wind activities would be that benthic resources may indirectly benefit from a reduction in bottom disturbance if fishing utilizing bottom trawls and dredge gear were to occur less within WTG arrays than under existing conditions; however, this fishing effort may simply move to other locations inside or outside of the geographic analysis area for benthic resources.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from **negligible** to **moderate** and **moderate beneficial**. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with past, present, reasonably foreseeable activities would result in **moderate** impacts to benthic resources in the analysis area. The main drivers for this impact rating are bottom temperature changes due to ongoing climate change, ongoing recurring bottom disturbance from bottom-tending fishing gear, and direct mortality resulting from offshore construction. The Proposed Action would contribute to the overall impact rating primarily through the temporary impacts due to new cable emplacement and permanent impacts from the presence of structures (cable protection measures and foundations). BOEM has considered the possibility of a **major** impact resulting from invasive species; this level of impact could occur if an invasive species were to adversely impact benthic ecosystem health or habitat quality at a regional scale. While it is an impact that should be considered, it is also unlikely to occur. Invasive species have already been documented on Georges Bank, and the risk of impacts within the benthic resources analysis area would be highly similar under the No Action Alternative or under the Proposed Action, as ongoing activities (e.g., shipping and marine debris) contribute most of the risk through this IPF. Thus, the overall cumulative impacts on benthic resources would likely qualify as **moderate** because a notable and measurable adverse impact is anticipated, but the resource would likely recover completely when the impacting agent were gone and remedial or mitigating action were taken.

3.3.2.2. Cumulative Impacts of Alternative B, C, D1, D2, and E

The direct and indirect impacts of Alternative B, C, D, or E on benthic resources are described in the Draft EIS Section 3.3.5. The impacts under Alternative B, C, D, or E would differ from those under the Proposed Action only in the incremental (direct and indirect) impacts of the proposed Project; the cumulative impact contributions from past, present, and reasonably foreseeable activities would be the same under any alternative. The direct and indirect impacts of Alternative B would be similar to those of the Proposed Action, but a lesser total impact compared to the maximum-case scenario under the Proposed Action, due to the shorter OECC and the avoidance of Lewis Bay; for details, see the Draft EIS Section 3.3.4.1 and the COP (Volume II, Section 5.1, and Appendix II-H; Epsilon 2018a). The direct and indirect impacts of Alternative C would be very similar to those under the Proposed Action (Draft EIS Section 3.3.5.5). The direct and indirect impacts of Alternatives D1 and D2 would be slightly greater than those under the Proposed Action due to an increase in inter-array cable (Draft EIS Section 3.3.5.6). Recent forecasts by Vineyard Wind estimate that the length of inter-array cabling would be approximately 186.4 miles (300 kilometers) under Alternative D1 or D2, which exceeds the maximum design parameter in the COP PDE of 171 miles (275 kilometers). The direct and indirect impacts of Alternative E would be less than those of the Proposed Action because IPFs associated with the installation of WTGs, including pile-driving noise, temporary habitat disturbance, turbidity, and sediment deposition, would be reduced by approximately 16 percent compared to the maximum-case scenario under the Proposed Action (Draft EIS Section 3.3.5.7). Overall, the direct and indirect impacts of Alternative B, C, D, or E on benthic resources would likely be **moderate** impacts, including the presence of structure, which may result in **moderate beneficial** impacts.

While Alternatives B and E may be slightly less impactful to benthic resources than the Proposed Action and Alternative D may be slightly more impactful to benthic resources than the Proposed Action, the cumulative impacts under Alternative B, C, D, or E would be similar to the cumulative impacts under the Proposed Action (with individual IPFs leading to impacts ranging from **negligible** to **moderate** and **moderate beneficial**). The overall cumulative impacts of Alternative B, C, D, or E when combined with past, present, and reasonably foreseeable activities on benthic resources within the geographic analysis area would be of the same level as under the Proposed Action—**moderate**. This impact rating is driven mostly by ongoing activities, such as climate change and bottom-tending fishing gear, as well as by the construction, installation, and presence of offshore wind structures.

3.3.2.3. Direct, Indirect, and Cumulative Impacts of Alternative F

Alternative F analyzes a vessel transit lane through the WDA, in which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The WTGs that would have been located within the transit lane would not be eliminated from the Proposed Action; instead, the displaced WTGs would be shifted to locations south within the lease area. Under this alternative, BOEM is analyzing a 2- and 4-nautical-mile northwest/southeast vessel transit lane through the WDA combined with any action alternative; however, this analysis focuses on the combination of Alternative F with either the Proposed Action or Alternative D2 layout. Therefore, the number of turbines would remain the same. The northern transit lane within the WDA could result in the relocation of 16 to 34 WTG placements, an increased extent of inter-array cables, and a 12 to 61 percent increase in the size of the WDA, (depending on whether the Proposed Action or Alternative D2 layout is used, and how wide the transit lane is).

The direct and indirect impacts of Alternative F on benthic resources would be greater than those of the Proposed Action (though of a similar level) because the length of inter-array cabling would increase and would exceed the maximum design parameter in the COP PDE of 171 miles (275 kilometers) due to the need to traverse a 2- or 4-nautical-mile transit lane; the seafloor area affected in the course of inter-array cable installation and operations and maintenance would also increase. Recent forecasts by Vineyard Wind estimate that the length of inter-array cabling would be approximately 221 miles (355 kilometers) under Alternative F with a 4-nautical-mile transit lane and the Proposed Action layout, and 234 miles (376 kilometers) with a 4-nautical-mile transit lane and the Alternative D2 layout; if the transit lane were only 2 nautical miles wide, the length of inter-array cabling would still exceed that in the COP PDE but would be somewhat less than with a 4-nautical-mile transit lane. Additional site characterization surveys may cause local temporary impacts that are difficult to detect. As stated previously, the geographic analysis area for benthic resources extends for a 10-mile (16.1-kilometer) radius around the WDA and the OECC proposed in the COP. As a result, and because WTGs would be relocated further south of the WDA as a result of the transit lane, Alternative F in combination with any other alternative or combination of alternatives would expand the area of potential effect for benthic resources. Slight changes in benthic communities could occur with changing location and depth in a different portion of the lease area, but BOEM anticipates these changes to be insignificant, based on the similarity of sediments and invertebrate communities across the WDA (COP Volume II, Appendix H-4; Epsilon 2018a). Therefore, expanding the WDA and shifting some activities and structures to the south/southwest would not likely affect different benthic resources or change the nature of potential impacts on benthic resources. For the same reason, the potential impacts on benthic resources of Alternative F do not depend on the other turbine layout constraints (Proposed Action, Alternative D2, or any other alternative) or on the width of the transit lane (2 nautical miles or 4 nautical miles), with the exception that a greater amount of cable would lead to greater impacts. While Vineyard Wind would have the liberty to configure the inter-array and inter-link cables within the bounds established by the final approved COP, the minimum cable length technically necessary to connect enough WTGs to meet the 800 MW generation capacity in the COP would likely be shortest for a 2-nautical-mile transit lane combined with the layout of the Proposed Action (or Alternative B or Alternative E) and the longest for a 4-nautical-mile transit lane combined with the layout of Alternative D2. In other respects, the direct and indirect impacts of Alternative F would be similar to those of the Proposed Action. Overall, the direct and indirect impacts of Alternative F on benthic resources would likely be **moderate**, including the presence of structure, which may result in **moderate beneficial** impacts.

Because the transit lanes are generally not oriented to existing fishing patterns (see details on commercial fishing in Section 3.11.2.6), it is not anticipated that there would be a substantial increase in the utilization of bottom-tending fishing gear in the transit lane. Thus, the difference in benthic impacts resulting from commercial fishing activity between Alternative F and the Proposed Action would likely be biologically insignificant in relation to existing commercial fishing activity in the geographic analysis area.

In considering the cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities, BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The cumulative impacts of Alternative F would be similar to the cumulative impacts under the Proposed Action (with individual IPFs leading to impacts ranging from **negligible** to **moderate** and **moderate beneficial**). The overall cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities on benthic resources would be of the same level as under the Proposed Action—**moderate**.

BOEM has qualitatively evaluated the cumulative impacts of implementing all six RODA-recommended transit lanes, including the northern transit lane described for Alternative F, as well as five other transit lanes through the RI and MA Lease Areas. To the extent additional transit lanes are implemented in the future outside of the WDA as part of RODA's suggestion, the WTGs for future offshore wind projects may need to be located further from shore, similar to the proposed Project under Alternative F. As a result, establishment of additional transit lanes could require increased lengths of offshore export cable and therefore effects to benthic resources. This could result in some activities that are uncertain and may lead to greater, lesser, or similar impacts on benthic resources. If in the future all six transit lanes were implemented, the overall number of WTGs would be reduced in the RI and MA Lease Areas and the expected power generation capacity could not be met with the assumed 1- by 1-nautical-mile WTG layout. For any project that would still develop the expected capacity, it would likely require an increased amount of inter-array cable. Given the uncertainty around how projects might be configured in this scenario, future offshore wind developments may include a greater total cable length (and more impact on benthic resources) and/or fewer foundations in the geographic analysis area (and less impact on benthic resources) than in a scenario without these transit lanes. If all six of RODA's suggested transit lanes were implemented, the total amount of permanent structure (e.g., foundations and scour protection) in the geographic analysis area would decrease, thus reducing the extent of permanent impacts.

3.3.2.4. Comparison of Alternatives

As discussed in the Draft EIS Section 3.3.5.9, the direct and indirect impacts associated with the Proposed Action do not change substantially under Alternatives B through E. Alternative B would avoid Lewis Bay, thus avoiding adverse impacts on shellfish beds in that location, and would reduce impacts proportional to the length of the OECC by approximately 9 percent compared to the maximum-case scenario under any other action alternative. Alternative E would reduce impacts related to the number of WTGs by approximately 16 percent compared to the maximum-case scenario under any other action alternative; it is important to note that not all impacts are related to the number of WTGs, and thus the total impact would be reduced by less than 16 percent; it is also important to note that Alternative E would reduce the potentially beneficial impacts as well as reduce the adverse impacts. Alternative E has the potential for the least impact on benthic resources due to fewer WTGs installed and the reduced footprint within the WDA. Alternative F would have direct and indirect impacts on benthic resources that would be greater than those of the Proposed Action because the length of inter-array cabling would increase. Although the amount of impacts from cabling varies among alternatives, the overall level of direct and indirect impacts would be similar for all action alternatives (**moderate**, including the presence of structure, which may result in **moderate beneficial** impacts). Ultimately, the same construction, operations and maintenance, and decommissioning activities would still occur, albeit at a reduced scale in some cases.

Cumulative impacts under any action alternative would likely be similar because the majority of the cumulative impacts result from ongoing activities and other future offshore wind projects. However, the differences in incremental impacts between action alternatives should still be considered alongside the impacts of other ongoing and future activities. Therefore, cumulative impacts on benthic resources from any action alternative would be similar with the level of individual impacts ranging from negligible to moderate and moderate beneficial. The overall cumulative impact of any action alternative when combined with past, present, and reasonably foreseeable activities would be moderate.

In conclusion, the overall level of cumulative impacts on benthic resources from any alternative, including the No Action Alternative, when combined with past, present, and reasonably foreseeable activities would be moderate. Cumulatively, gear utilization for dredging and bottom trawling, the presence of structures, pile-driving noise, anchoring, new cable emplacement and maintenance, sediment deposition and burial, and climate change are expected to lead to noticeable temporary and permanent adverse impacts across much of the geographic analysis area. The presence of new structures could benefit some benthic communities that depend on hard structure.

3.4. Finfish, Invertebrates, and Essential Fish Habitat

3.4.1. No Action Alternative Impacts

Table 3.4-1 contains a detailed summary of baseline conditions and the impacts of ongoing and future offshore activities other than offshore wind on finfish, invertebrates, and essential fish habitat (EFH), based on the IPFs assessed. This information comes primarily from the Draft EIS, supplemented by additional information from NOAA, other fisheries management bodies, and other sources consulted in the course of responding to comments on the Draft EIS. The impact analysis is limited to impacts within the geographic analysis area for finfish, invertebrates, and EFH as described in Table A-1 in Appendix A and shown on Figure A.7-4, namely, U.S. waters of the Northeast Shelf Large Marine Ecosystem (LME).

Finfish, invertebrates, and EFH in the geographic analysis area are subject to pressure from ongoing activities, especially harvest, bycatch, water quality issues, dredging and bottom trawling, and climate change. In the New England and Mid-Atlantic regions, 16 fish stocks are in an overfished condition and seven (7) are currently subject to overfishing (NOAA 2019a). Lobster catches in southern New England have declined sharply since the late 1990s. The understanding and rebuilding of finfish and invertebrate stocks are complicated by variables such as long-term shifts occurring at the base of the food web (Perretti et al. 2017) and warming ocean temperatures (Hare et al. 2016). Water quality impacts from ongoing onshore and offshore activities affect nearshore habitats and food webs. Dredging for navigation, marine minerals extraction, and/or military uses, as well as commercial fishing using bottom trawls and dredge fishing methods, disturbs seafloor habitat on a recurring basis. Commercial and recreational fishing using other methods results in mortality of finfish and invertebrates through harvest and bycatch. Commercial and recreational fishing gear are periodically lost, but they can continue to capture or otherwise harm finfish and invertebrates; the lost gear, moved by currents, create small, short-term, localized impacts. Ongoing impacts resulting from fishing pressure, especially via dredging and bottom trawling gear, will continue regardless of the offshore wind industry. Invasive species are periodically released accidentally during ongoing activities, including the discharge of ballast water and bilge water from marine vessels. The impacts on finfish, invertebrates, and EFH depend on many factors, but can be widespread and permanent, especially if the invasive species becomes established and out-competes native fauna.

Under the No Action Alternative, the proposed Project would not be built and hence would have no impact on finfish, invertebrates, and EFH. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. If the Vineyard Wind 1 Project is not approved, then impacts from the proposed Project would not occur as proposed. However, the state demand that the Vineyard Wind 1 Project would have filled, if approved, could likely be met by other projects in the geographic analysis area for finfish, invertebrates, and EFH. Therefore, the impacts on finfish, invertebrates, and EFH would be similar, but the exact impact 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 and considers the assumptions included in Section 1.2 and Appendix A. A detailed analysis of impacts associated with future offshore wind development is provided in Section 3.4.1.1 and summarized in Table 3.4-1. Cumulative impacts of the Proposed Action and action alternatives are analyzed in Section 3.4.2.

3.4.1.1. Future Offshore Wind Activities (without Proposed Action)

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

Accidental releases: Accidental releases may increase as a result of future offshore wind activities. Section A.8.2 discusses the nature of releases anticipated. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities.

Refer to Section A.8.2 for details regarding the risk of accidental releases of fuel/fluids/hazmat. Using the assumptions in Table A-4 in Appendix A, there would be a low risk of a release from any of 2,021 WTGs and 45 ESPs, with a total of approximately 13.1 million gallons (49.6 million liters) of fuel/fluids/hazmat contained in all offshore wind facilities. According to BOEM's modeling (Bejarano et al. 2013), a release of 128,000 gallons (484,532.7 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 likelihood of a spill occurring from multiple WTGs and ESPs 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. Based on these rates, the additional impact of releases from future offshore wind facilities, the risk of which would primarily exist during construction, but also during operations and decommissioning, would fall within the range of accidental releases that already occur on an ongoing basis.

Invasive species can be released accidentally, especially during ballast water and bilge water discharges from marine vessels. Increasing vessel traffic related to the offshore wind industry would increase the risk of accidental releases of invasive species, primarily during construction. The impacts of releases of invasive species 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. The increase in this risk related to the offshore wind industry would be small in comparison to the risk from ongoing activities.

Overall, accidental releases are anticipated to be short term and localized, and to result in little change to finfish, invertebrates, and EFH. As such, accidental releases from future offshore wind development would not be expected to contribute appreciably to overall impacts on finfish, invertebrates, and EFH.

Anchoring: Vessel anchoring can cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. In addition, anchoring and mooring of met towers or buoys could be increased. Anchoring would cause increased turbidity levels and would have the potential to cause mortality of finfish and invertebrates and, possibly, degradation of sensitive habitats. The actual impact of each anchoring event would depend on location, habitat type, and time of year. Impacts on finfish, invertebrates, and EFH are greatest for sensitive EFH (e.g., eelgrass, hard bottom) and sessile or slow-moving species (e.g., corals, sponges, and sedentary shellfish). In the expanded cumulative scenario, there would be increased anchoring of vessels during survey activities and during the construction, installation, maintenance and decommissioning of offshore components. Using the assumptions in Table A-4 in Appendix A, anchoring of vessels during cable installation could affect up to approximately 276 acres (1.1 km^2) over the next 10 years. All impacts would be localized, turbidity would be temporary, and mortality from direct contact would be recovered in the short term. Degradation of sensitive habitats, if it occurs, could be long-term. Anchoring is a series of separate events, each affecting only a small area of seafloor; therefore, even when multiple projects in a region occur simultaneously or consecutively, it is unlikely that a second anchor or chain would hit a portion of seafloor affected by an earlier anchor or chain.

EMF: Biologically significant impacts on finfish, invertebrates, and EFH have not been documented for EMF from alternating current (AC) cables (CSA Ocean Sciences, Inc. and Exponent 2019; Thomsen et al. 2015). In the United States, behavioral impacts have been documented for benthic species (skates and lobsters) near operating DC cables (Hutchison et al. 2018). The impacts are localized and affect the animals only while they are within the EMF. There is no evidence to indicate that EMF from undersea AC power cables adversely affects commercially and recreationally important fish species within the southern New England area (CSA Ocean Sciences, Inc. and Exponent 2019). Operating cables related to future offshore wind activities other than the proposed Project would produce EMF to some degree. The cable routes for those projects have not been determined at this time. In the expanded cumulative scenario, up to 5,947 miles (9,571 kilometers) of cable would be added in the geographic analysis area for finfish, invertebrates, and EFH, producing EMF in the immediate vicinity of each cable.

Submarine power cables in the geographic analysis area for finfish, invertebrates, and EFH are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF resulting from cable operation to low levels. EMF of any two sources would not overlap because developers typically allow at least 330-foot (100-meter) spacing between cables (even for multiple cables within a single OECC), EMF strength diminishes rapidly with distance, and potentially meaningful EMFs would likely extend less than 50 feet (15.2 meters) from each cable. A migrating individual may encounter EMF on multiple occasions, each time potentially experiencing a behavioral impact during the time it is exposed to the EMF. Most exposures are expected to last for minutes, not hours, and the affected area would represent only a tiny portion of the available habitat for most migratory species, many of which travel several miles in a day (CSA Ocean Sciences, Inc. and Exponent 2019). Although the EMF would exist as long as a cable was in operation, impacts on finfish, invertebrates, and EFH would likely be biologically insignificant.

Light: Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light can also disrupt natural cycles, e.g., spawning. Offshore wind development would result in additional light from vessels and from offshore structures. Downward-directed deck lighting would have a much greater affect than the navigational lights required on vessels or structures. Construction vessels would be lit during construction, maintenance, and decommissioning and would follow BOEM guidelines for lighting. The impact would likely be small relative to non-wind industry activities. There may or may not be nighttime construction where lighting impacts would be most acute; in a maximum-case scenario, lights could be active 24 hours per day during construction. This could attract finfish and invertebrates to construction zones, potentially exposing them to greater harm from other IPFs (e.g., noise).

Up to 2,021 WTGs and 45 ESPs would have navigation and/or aviation hazard lights during operation (in accordance with BOEM's lighting and marking guidelines), and these would be incrementally added over time. This would increase the amount of light on the OCS. Because navigation and/or aviation hazard lights are not downward-focused lighting, the amount of such light penetrating the sea surface is anticipated to be minimal and not likely to cause impacts on finfish, invertebrates, and EFH.

New cable emplacement/maintenance: Cable emplacement/maintenance activities could disturb, displace, and injure finfish and invertebrates and result in temporary turbidity and short-term to long-term habitat alterations. The intensity of impacts would depend on the time (season) and place (habitat type) where the activities occur. This IPF causes direct impacts during construction and maintenance (see also the IPF of Sediment deposition and burial). Assuming future projects use installation procedures similar to those proposed in the proposed Project COP (Epsilon 2020a), the extent of impacts would be limited to approximately 6 feet (2 meters) to either side of each cable, and finfish, invertebrates, and most EFH would recover following disturbance, although some habitats would not fully return to their previous conditions. Using the assumptions in Appendix A, the total area of seafloor disturbed by cable emplacement for offshore wind facilities is estimated to be up to 8,153 acres (33.0 km^2). The geographic analysis area for finfish, invertebrates, and EFH contains over 16 million acres (64,750 km^2) of gravel or hard bottom, over 46 million acres (186,155 km^2) of sand bottom, and over 15 million acres (60,703 km^2) of silt/mud bottom, according to an internal analysis of data from The Nature Conservancy (2014). The affected area for any one of those sediment types would be less than 0.1 percent of the total area of that type. The cable routes have not been determined at this time. Short-term effects on populations could occur in the immediate vicinity of installation activities. Turbidity would be increased during construction for 1 to 6 hours at a time. Cable routes that intersect habitat areas of particular concern, including eelgrass and hard-bottom habitats, may cause impacts that may be long-term to permanent; otherwise, impacts of habitat disturbance and mortality from direct contact would be recovered in the short term. Any dredging necessary prior to cable installation could also contribute additional impacts.

Noise: Noise from construction, pile driving, G&G survey activities, aircraft, trenching, operations and maintenance, and vessels could contribute to impacts on finfish, invertebrates, and EFH. The noise having the greatest impact is expected to come from pile driving.

In the expanded cumulative scenario, construction of 2,066 offshore structures would create noise that affects finfish, invertebrates, and EFH. The greatest impact of noise is likely to be caused by pile driving. Noise from pile driving would be temporary, occurring during installation of foundations for offshore structures. This noise would be produced during construction for 4 to 6 hours at a time over a 6- to 10-year period. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to finfish and invertebrates in a limited space around each pile and can cause short-term stress and behavioral changes to individuals over a greater space. The extent depends on pile size, hammer energy, and local acoustic conditions; based on estimates from the COP (Section 4.2.3, Epsilon 2020a; Pyć et al. 2018), behavioral effects from pile-driving noise would likely extend radially less than 5.7 miles (8 kilometers) around each pile, and the radius for injury or mortality is estimated to extend 285 feet (87 meters) from each pile. Therefore, the radius for potential injury or mortality would not overlap between any two foundations; the radius for behavioral effects could overlap among two or more foundations if multiple piles are driven simultaneously by one project or multiple projects. If all 2,066 foundations in the expanded cumulative scenario are summed, the risk of injury or mortality is expected to occur over approximately 12,102 acres (48 km^2). Potentially injurious noise could also be considered as rendering EFH temporarily unavailable or unsuitable for the duration of the noise. The affected areas of seafloor would likely be recolonized in the short term, whereas the water around the foundation would cease to be affected immediately after the noise ceases. Eggs, embryos, and larvae of finfish and invertebrates could also experience developmental abnormalities or mortality resulting from this noise, although thresholds of exposure have not been defined as they have for adult finfish (Weilgart 2018; Hawkins and Popper 2017). The impact of pile-driving noise on finfish and invertebrates would depend on the time of year it occurs; the impact could be greater if the noise occurs in spawning habitat during a spawning period, particularly for those species that aggregate to spawn (e.g., Atlantic cod [*Gadus morhua*]), use sound to communicate (e.g., Atlantic cod), or spawn only once during their lifetime (e.g., longfin squid [*Doryteuthis pealeii*]). It is anticipated that most pile-driving activity would occur in the summer months when weather windows are favorable. Thus, species that spawn in the summer (e.g., longfish squid, bluefish [*Pomatomus saltatrix*]) would be more susceptible to disturbance from pile-driving noise.

Reduced reproductive success in one or more spawning seasons could result, which could potentially result in long-term effects to populations if one or more year classes suffer suppressed recruitment. Recent studies on the behavioral impacts of pile-driving noise on black sea bass (*Centropristis striata*) and longfin squid have shown behavioral responses, but behavior returns to a pre-exposure state after the cessation of the noise (Jones et al. 2020; Shelledy et al. 2018). In the expanded cumulative scenario, noise from pile driving could affect the same populations or individuals multiple times in 1 year or in sequential years; it is currently unknown whether it would have less impact to drive many piles sequentially or concurrently.

Noise from G&G surveys of cable routes and other site characterization surveys for offshore wind facilities could also affect finfish and invertebrates. G&G noise would occur intermittently over an assumed 2- to 10-year construction period. It is important to note that G&G noise resulting from offshore wind site characterization surveys is less intense than G&G noise from seismic surveys used in oil and gas exploration; while airgun seismic surveys create high-intensity impulsive noise to penetrate deep into the seabed, offshore wind site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves needed for only shallow seabed penetration. These activities can disturb finfish and invertebrates in the investigation's immediate vicinity and can cause temporary behavioral changes.

Noise from aircraft, trenching/cable burial, vessels, and WTG operations and maintenance are expected to occur, but would have little effect on finfish, invertebrates, and EFH. Offshore wind projects may use aircraft for crew transport during maintenance and/or construction; however, very little of the aircraft noise propagates through the water, and therefore there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH. Noise from trenching of inter-array and export cables would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching/cable burial noise are typically less prominent than the impacts of the physical disturbances discussed under new cable emplacement/maintenance and sediment deposition and burial. Future offshore wind activities would also increase vessel noise. Analysis of vessel noise related to the Cape Wind Energy Project found that noise levels from construction vessels at 10 feet (3 meters) were loud enough to induce avoidance, but not physically harm finfish and/or invertebrates (MMS 2009). Behavioral impacts would likely be temporary. Finally, 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 adversely affect finfish, invertebrates, and EFH (English et al. 2017). As measured at the Block Island Wind Farm, the low-frequency noise from WTG operation barley exceeds ambient levels at 164 feet (50 meters) from the WTG base. Based on the results of Thomsen et al. (2015) and Kraus et al. (2016a), sound pressure levels would be expected to be at or below ambient levels at relatively short distances from WTG foundations (about 164 feet [35.4 meters]).

Port utilization: It is likely that ports would be upgraded along the East Coast, increasing the total amount of disturbed habitat. Ports are largely privately owned or managed businesses that are expected to compete against each other for offshore wind business. The ports of New Bedford, Hampton Roads, Atlantic City, Ocean City, and Montauk have been identified as possible ports to support offshore wind energy construction and/or operations, and smaller ports could also be upgraded and used for operation and maintenance support. For example, in Vineyard Haven, barrier beach and intertidal habitat would be affected by foreseeable port upgrades, potentially converting these important fish habitats to developed structure. Increases in port utilization due to offshore wind projects would lead to increased vessel traffic. Port expansions would likely happen over the next 6 to 10 years, and the increase in port utilization would be at its peak during construction activities and would decrease during operations but would increase again during decommissioning. In addition, any related port expansion and construction activities related to offshore wind projects would add to the total amount of disturbed habitat, possibly including EFH. Existing ports have already affected finfish, invertebrates, and EFH by temporarily displacing finfish and invertebrates and disturbing habitats, as well as permanently converting habitats; future port expansions would implement BMPs (e.g., stormwater management, turbidity curtains) to minimize impacts. Although the degree of impacts on EFH would likely be undetectable outside the immediate vicinity of the ports, impacts on EFH for certain species and/or life stages may lead to impacts on finfish and invertebrates beyond the vicinity of the port.

Presence of structures: The presence of structures can lead to impacts on finfish, invertebrates, and EFH through entanglement and gear loss/damage, hydrodynamic disturbance, fish aggregation, habitat conversion, and migration disturbances. These impacts may arise from buoys, met towers, foundations, scour/cable protection, and transmission cable infrastructure. Using the assumptions in Table A-4 in Appendix A, the expanded cumulative scenario would include up to 2,066 foundations, 1,723 acres (7.0 km^2) of foundation scour protection, and 1,221 acres (4.9 km^2) of new hard protection atop cables. Projects may also install more buoys and met towers. BOEM anticipates that structures would be added intermittently over an assumed 6- to 10-year period and that they would remain until decommissioning of each facility is complete. This would be a substantial increase in structure, which is presently rare throughout the geographic analysis area for finfish, invertebrates, and EFH.

The presence of structures may indirectly increase private and for-hire recreational fishing effort in areas where there was not effort previously and increase the risk of gear loss/damage by entanglement with structure. Commercial fisheries operating near structure may also experience gear loss, potentially indirectly increasing the impacts of ghost fishing and other disturbances on finfish, invertebrates, and EFH. Lost commercial fishing gear moved by currents can disturb habitats and potentially harm individuals. Such impacts at any one location would likely be short-term and localized, although the increased risk of occurrence would persist as long as the structures remain.

Manmade structures, especially tall vertical structures such as foundations, alter local water flow at a fine scale. A modeling study by Chen et al. (2016) found that WTG foundations in the southern New England region would not have a significant influence on southward larval transport during storm events, although foundation placement could either increase or decrease larval dispersion and speed, depending on initial location; however, the models never found the foundations to trap or block larval transport. Tank and modelling tests, such as those conducted by Miles et al. (2017) and Cazenave et al. (2016), conclude that mean flows are reduced/disrupted immediately downstream of a monopile foundation, but return to background levels within a distance proportional to the pile diameter (D). These results indicate disruptions for a horizontal distance anywhere between 3.5 D to 50 D, depending on whether it is a current only regime or a wave and current regime, and a width of 65.6 to 164 feet (20 to 50 meters). Thus, for foundations like those proposed by Vineyard Wind, background conditions would be expected between 164 to 1,148 feet (50 to 350 meters) downstream from each monopile foundation. Cazenave et al. (2016) also conducted a shelf-scale modeling exercise on the Irish Sea, home to Walney (+extensions) and West of Duddon Sands, contiguous offshore wind facilities that together contain 297 turbines (with 1.4 GW total power generation capacity). The shelf-scale model of the eastern Irish Sea indicated a 5 percent reduction in peak water velocities, and found that this reduction may extend up to approximately 0.5 nautical mile (1 kilometer) downstream of a monopile foundation and that impacts varied based on array geometry. In general, modeling studies indicate that water flow typically returns to within 5 percent of background levels within a relatively short distance from the structure. Given this, the disruption to mean flows is not likely to reach from one foundation to an adjacent foundation.

Altered hydrodynamics can increase seabed scour and sediment suspension around foundations, resulting in sediment plumes. Sediment plumes around foundations, seen in shallow-water and high-current velocity systems, are not expected in current leased areas on the U.S. OCS. U.S. wind energy areas are generally deeper, where hydrodynamics are less impacted by tidal forcing. The water depth of BOEM's current active offshore wind leases typically range from 59 to 197 feet (18 to 60 meters), whereas the early projects in the North Sea were between 9.8 and 65.6 feet (3 and 20 meters) of water depth. While the surface currents in the U.S. wind energy areas are comparable to those at European wind developments, the bottom currents are typically less, due to the greater water depth. Lower bottom currents lead to a reduction in the potential for scour, the time sediments remain suspended within the water column, and the distance suspended sediments travel. Scour protection measures, such as rock at the base of the foundations, further reduce sediment resuspension due to scour. Thus, effects on finfish, invertebrates, and EFH from sediment resuspension near foundations are not anticipated to be measurable above existing natural/baseline conditions.

The changes in fluid flow caused by the presence of many structures on the OCS could also influence finfish, invertebrates, and EFH at a broader spatial scale. The existing physical oceanographic conditions in the geographic analysis area for finfish, invertebrates, and EFH, with a particular focus on the southern New England region, are described in Appendix B of the Draft EIS. Although waters on the OCS experience considerable vertical mixing in fall, winter, and spring, an important seasonal feature influencing finfish and invertebrates is the cold pool, a mass of cold bottom water in the mid-Atlantic bight overlain and surrounded by warmer water. The cold pool forms in late spring and persists through summer, gradually moving southwest, shrinking, and warming due to vertical mixing and other factors (Chen et al. 2018). During summer, local upwelling and local mixing of the cold pool with surface waters provides a source of nutrients, influencing the ecosystem's primary productivity, which in turn influences finfish and invertebrates (Lentz 2017; Matte and Waldhauer 1984). The presence of many wind turbine structures could affect local oceanographic and atmospheric conditions by reducing wind-forced mixing of surface waters and increasing vertical mixing of water forced by currents flowing around foundations (Carpenter et al. 2016; Cazenave et al. 2016; Schultze et al. 2020). During times of stratification (summer), increased mixing could possibly increase pelagic primary productivity in local areas. Changes in primary productivity might not translate into effects on finfish and commercially important invertebrates if the increased productivity is consumed by filter feeders, such as mussels that colonize the structure surfaces (Slavik et al. 2019). Increased mixing may also result in warmer bottom temperatures. Warmer bottom temperatures may increase stress on some shellfish and fish that are at the southern/inshore extent of their temperature tolerance. The ultimate impacts on finfish and invertebrates of changes to local oceanographic and atmospheric conditions caused by the presence of offshore structures are expected to be localized, and likely to vary seasonally and regionally.

Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables would create uncommon relief in a mostly sandy seascape. Structure-oriented fishes would be attracted to these locations. Abundance of certain fishes may increase (Claisse et al. 2014; Smith et al. 2016) near the structures. These impacts would be local and likely permanent as long as the structures remain. The effects of fish aggregating around structures may be considered adverse, beneficial, or neutral to finfish and invertebrate populations, as the dynamics of predation and fishing would vary by location.

In addition to fish aggregation, the new structure may also provide new hard-structure habitat for structure-oriented and/or hard-bottom species, which may benefit. Cable protection, scour protection, and foundations would convert habitat from a soft-bottom to hard-structure habitat, although it would differ from the typical hard-bottom habitat in the geographic analysis area for finfish, invertebrates, and EFH, namely, coarse substrates in a sand matrix. This would constitute a modification of the existing soft-bottom or hard-bottom habitat, and it may or may not function similarly to hard-bottom habitat typical in the region (Kerckhof et al. 2019; HDR 2019). Soft bottom is the dominant habitat type from Cape Hatteras to the Gulf of Maine (over 60 million acres [242,811 km^2]), and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). The new surfaces could also be colonized by invasive species (e.g., certain tunicate species) found in hard-bottom habitats on Georges Bank (Frady and Mecray 2004). The new structures could create an artificial reef effect, attracting a different community of fish and invertebrates in the immediate vicinity of the structures. Species preferring hard-bottom habitat (e.g., Atlantic cod, American lobster [*Homarus americanus*], black sea bass, striped bass [*Morone saxatilis*], etc.) would gain habitat while obligate soft-bottom species (e.g., summer flounder [*Paralichthys dentatus*], Atlantic surfclam [*Spisula solidissima*], longfin squid) would see habitat locally reduced. The attraction of structure-oriented predators (e.g., black sea bass) may have indirect impacts on prey species, including lobster. The reef effect has been observed around WTGs, leading to local increases in biomass and diversity (Causon and Gill 2018); however, the diversity may decline over time as early colonizers are replaced by successional communities dominated by blue mussels and anemones (Kerckhof et al. 2019). Invertebrate and fish assemblages may develop around these reef-like elements within the first year or two after construction (English et al. 2017). Although some studies have noted increased biomass and increased production of particulate organic matter by epifauna growing on submerged foundations, it is not clear to what extent the reef effect results in increased productivity versus simply attracting and aggregating fish from the surrounding areas (Causon and Gill 2018). Recent observations at the Block Island Wind Farm have reported considerable colonization by mussels (ten Brink and Dalton 2018; HDR 2019). The potential effects of offshore wind facilities on offshore ecosystem functioning has been studied using simulations calibrated with field observations (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019). These studies indicated that the offshore wind facilities increased bivalve biomass and shifted the local food webs toward a greater amount of detritivory.[1] They also found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, marine mammals, and birds as well. Overall, omnivory,[2] energy recycling, and general ecosystem activity all increased after offshore wind facility construction (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019). These changes do not necessarily happen across an entire offshore wind facility, but are likely concentrated around the vicinity of each structure. Various attempts to measure the linear extent of the reef effect have reported distances from 52.5 feet (16 meters) (Stanley 1994) to 1,968.5 feet (600 meters) (Kang et al. 2011) from a structure, and Rosemond et al. (2018) have suggested assuming a distance of 98 to 197 feet (30 to 60 meters) as a first approximation. These studies indicate that offshore wind facilities can generate beneficial impacts on local ecosystems. The presence of many distinct hard structure areas could also increase connectivity between geographically distant populations (Folpp et al. 2011; Mora et al. 2003), as the structures may provide patches of attractive habitat, helping structure-oriented species traverse the mostly sandy OCS.

Future offshore wind structures would lie in the paths of some migratory species, including finfish and invertebrates that exhibit onshore/offshore seasonal migrations (e.g., summer flounder, longfin squid, monkfish [*Lophius* spp.], black sea bass, and lobster). Structures can attract finfish and invertebrates that approach the structures during their migrations. This could tend to slow migration if migrating individuals choose to find food or shelter at the structure instead of proceeding at their typical pace of travel. However, temperature is expected to be a bigger driver of habitat occupation and migration than structure would be (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded.

In addition to these studies, some countries like Belgium and Denmark have funded long-term monitoring programs (Bergstrom et al. 2014; Kerckhof et al. 2019). These studies broadly show that long-term operational impacts on the marine benthic environment (e.g., increased animal abundances) are evident close to foundations and scour protection, and no impacts have been evident at the scale of an entire facility (Bergstrom et al. 2014). In Belgium, monitoring conducted at wind facilities between 2005 and 2016 found the number of epibenthic and demersal-benthopelagic fish species remained similar over the years and was not affected by the construction of the wind facilities (Kerckhof et al. 2019). Epibenthic density and biomass showed a similar trend with an increase in the first two years after construction. These higher values however levelled off three years after construction. As for epibenthos, demersal-benthopelagic fish seemed to show more variance in densities only in the first few years after construction. These results indicate that the soft sediment ecosystem in between the turbines (at distances greater 656 feet [200 meters]) has not changed substantially 5 to 6 years after construction and that species assemblages within the offshore wind farms seem to be mainly structured by temporal variability at larger spatial scales (e.g., temperature fluctuations, hydrodynamic changes, plankton blooms). Similar to studies in other parts of the North Sea, there were some species of fish that seemed to respond positively to the offshore wind facility, but these potentially beneficial effects cannot be untangled from the reduction in fishing effort within the wind facility. With the exception of the United Kingdom, European countries have prohibited mobile trawl fishing within offshore wind facilities.

Considering the above information, BOEM anticipates that the impacts of the presence of structures on finfish, invertebrates, and EFH may be neutral to beneficial. These impacts would be permanent as long as the structures remain.

Regulated fishing effort: While primarily an ongoing activity, regulated fishing effort directly impacts finfish, invertebrates, and EFH by modifying the nature, distribution, and intensity of fishing-related impacts (mortality, bottom disturbance). Regulated fishing effort results in the removal of a substantial amount of the annually produced biomass of commercially regulated finfish and invertebrates

[1] The state of being a detritivore, i.e., a detritivore is an organism that obtains its nutrition by feeding on detritus.
[2] The state of being omnivorous, i.e., an omnivorous animal is one that has the ability to eat and survive on both plant and animal matter.

and can also influence bycatch of non-regulated species. Future offshore wind development other than the proposed Project could indirectly influence finfish, invertebrates, and EFH through this IPF by indirectly 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 3.11.1 provides details.

Seabed profile alterations: Dredging used in the course of cable installation can cause localized, short-term impacts (habitat alteration, change in complexity) on finfish, invertebrates, and EFH through seabed profile alterations, as well as through sediment deposition. The level of impact from seabed profile alterations could depend on the time of year that they occur, particularly in nearshore locations, especially if they overlap with times and places of high finfish and invertebrate abundance or sensitive life stages. The need for dredging depends on local seafloor conditions; assuming the areal extent of such impacts is proportional to the length of cable installed, such impacts from future offshore wind activities other than the proposed Project would likely be on the order of 20 times more than the proposed Project alone. Dredging is most likely in sand wave areas where typical jet plowing is insufficient to meet target cable burial depth. Sand waves that are dredged would likely be redeposited in like sediment areas. Any particular sand wave may not recover to the same height and width as pre-disturbance, however, the habitat function would largely recover post-disturbance. Therefore, seabed profile alterations, while locally intense, have little impact on finfish, invertebrates, and EFH on a regional (Cape Hatteras to Gulf of Maine) scale.

Sediment deposition and burial: Dredged material disposal during construction would cause temporary, localized turbidity increases and long-term sedimentation or burial at the immediate disposal site. Cable emplacement/maintenance activities (including dredging) during construction or maintenance of future offshore wind projects could cause sediment suspension for 1 to 6 hours at a time, after which the sediment is deposited on the seafloor. Sediment deposition could have impacts on demersal eggs and larvae, such as longfin squid eggs (which are known to have high rates of mortality if egg masses are exposed to abrasion or burial), winter flounder eggs, and shellfish larvae. Impacts may vary based on season or time of year and location. Assuming the areal extent of such impacts is proportional to the length of cable installed, such impacts would likely be on the order of 20 times more than the proposed Project (i.e., the proposed Project estimated that it would cause sediment deposition on up to 2,594 acres [10.5 km^2]). Increased sediment deposition may occur during multiple years. The area with a cumulatively greater sediment deposition from simultaneous or sequential activities would be limited, as most of the impacted areas would only be lightly sedimented (less than 0.04 inch [1 millimeter]) and would recover naturally in the short term.

Climate change: Finfish, invertebrates, and EFH may be affected by climate change, primarily from increasing ocean surface and bottom temperatures, which has been shown to impact the distribution of fish in the northeast United States, with several species shifting their centers of biomass either northward or to deeper waters (Hare et al. 2016). As a result of climate change, the composition of the fish assemblage in any particular location, and the seasonal dynamics of that assemblage, may change, potentially indirectly leading to changes in fishing activity. Warming of ocean waters is expected to influence the migrations of finfish and invertebrates and may influence the frequencies of various diseases (Hoegh-Guldberg and Bruno 2010; Brothers et al. 2016). Carbon dioxide emissions also cause ocean acidification, possibly contributing to reduced growth or the decline of invertebrates that have calcareous shells (PMEL 2020). Refer to Section A.8.1 for details on the expected contribution of offshore wind activities to climate change.

Other considerations: The endangered Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) is the only finfish or invertebrate listed under the Endangered Species Act (ESA) that may be affected by the proposed Project. The Atlantic sturgeon is likely to occur in offshore waters in the winter months, moving in a southward and offshore direction as inshore/northern waters become colder. Ongoing activities, future non-offshore wind activities, and future offshore wind activities other than the proposed Project may also affect the Atlantic sturgeon. Because all five Distinct Population Segments of the Atlantic sturgeon could be affected by the proposed Project, the geographic analysis area for finfish, invertebrates, and EFH for this species is its entire range, approximated by Figure A.7-5. According to the analysis in BOEM's Biological Assessment (BA) for the Proposed Action (BOEM 2019b), all of the IPFs and impacts on finfish and EFH discussed above could also apply to the Atlantic sturgeon. The most prominent IPF for sturgeon is likely to be noise from pile driving; however most pile driving is anticipated to occur in the summer, when Atlantic sturgeon are more likely to reside in rivers and nearshore waters, thus minimizing their exposure to pile-driving noise.

3.4.1.2. Conclusions

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impacts on finfish, invertebrates, and EFH. BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing temporary to permanent impacts (disturbance, displacement, injury, mortality, reduced reproductive success, habitat degradation, habitat conversion) on finfish, invertebrates, and EFH, primarily through resource exploitation/regulated fishing effort, dredging, bottom trawling, bycatch, G&G survey noise, pile-driving noise, new cable emplacement, the presence of structures, and climate change.

Considering all the IPFs together, BOEM anticipates that the overall impacts associated with the future offshore wind activities in the geographic analysis area would result in moderate adverse impacts and could potentially include moderate beneficial impacts. Future offshore wind activities are expected to contribute considerably to several of these IPFs, the most prominent being the presence of structures, namely foundations and scour/cable protection. The majority of offshore structures in the geographic analysis area for finfish, invertebrates, and EFH would be attributable to the future offshore wind industry. The future offshore wind industry would also be responsible for the majority of impacts related to new cable emplacement and to pile-driving noise. However, BOEM expects that ongoing impacts resulting from fishing pressure, especially via dredging and bottom trawling methods, would continue to be one of the most impactful IPFs controlling the condition of finfish and invertebrates in the geographic analysis area for finfish, invertebrates, and EFH.

Under the No Action Alternative, finfish, invertebrates, and EFH would continue to follow current regional trends and respond to current and future environmental and societal activities. The No Action Alternative would forgo the fisheries monitoring that Vineyard

Wind has committed to voluntarily perform, the results of which could provide an understanding of the effects of offshore wind development, benefit future management of finfish, invertebrates, and EFH, and inform planning of other offshore developments; however, other ongoing and future surveys could still provide similar data to support similar goals.

3.4.2. Proposed Action and Action Alternatives

3.4.2.1. Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on finfish, invertebrates, and EFH were described in Draft EIS Section 3.3.6.3, and additional information is included in Table 3.4-1. The Proposed Action would likely result in impacts (disturbance, displacement, injury, mortality, reduced reproductive success, habitat degradation, habitat conversion) that are expected to be local and to not alter the overall character of finfish, invertebrates, and EFH in the geographic analysis area for finfish, invertebrates, and EFH. The potential impacts would partially depend on which offshore export cable route and landfall method were chosen, so this analysis assumes the maximum-case scenario. Some impacts would be adverse and some could be beneficial; overall, the direct and indirect impacts of the Proposed Action on finfish, invertebrates, and EFH would likely be moderate, including the presence of structure, which may result in moderate beneficial impacts.

The Proposed Action would contribute to impacts through all the IPFs named in Section 3.4.1.1 except for light from vessels and port utilization; the Proposed Action would not involve changes to port utilization (and the Proposed Action's use of an already upgraded and operating port facility is not expected to impact finfish, invertebrates, and EFH). The most impactful IPFs would likely include pile-driving noise, which would cause mortality, injury, and behavioral changes for 4 to 6 hours at a time during construction; new cable emplacement, which would cause mortality, injury, turbidity, and short-term to long-term habitat degradation; and the presence of structures, which would lead to a permanent, possibly beneficial, impact as long as the structures remain. Other IPFs would likely contribute impacts of lesser intensity and extent, and would occur primarily during construction, but also during operations and decommissioning. For details, refer to Table 3.4-1.

Six IPFs or sub-IPFs in Table 3.4-1 were not discussed previously in the Draft EIS sections regarding finfish, invertebrates, and EFH. The first, accidental releases of invasive species from vessels associated with the Proposed Action, would have a low risk of resulting in widespread and permanent impacts. The increase in risk of accidental releases of invasive species attributable to the Proposed Action would be negligible.

Impacts from anchoring were discussed only in Draft EIS Section 3.3.5.3. Subsequent to publication of the Draft EIS, BOEM decided to assess specifically the potential impacts of anchoring on finfish, invertebrates, and EFH. Anchoring used in the course of the Proposed Action would leave marks on the seabed, increase turbidity levels, and have the potential for direct contact to cause mortality of benthic and demersal species. The COP (Volume II; Epsilon 2018a) estimated that anchoring would disturb up to 4.4 acres (17,806 m^2). All impacts would be localized, turbidity would be temporary, and most impacts from direct contact would be recovered in the short term. Degradation of sensitive habitats such as certain types of hard bottom (e.g., boulder piles), if it occurs, could be long-term. The Proposed Action would not anchor in eelgrass. The anticipated direct and indirect impacts of anchoring on finfish, invertebrates, and EFH would be minor.

The Draft EIS also did not contemplate light as an IPF affecting finfish, invertebrates, and EFH. The Proposed Action would allow nighttime work only on an as-needed basis (and would not allow pile driving to begin at night), in which case the Project would reduce lighting of vessels, so light from vessels is not anticipated to result in biologically meaningful impacts on finfish, invertebrates, and EFH. Up to 100 turbines and 2 ESPs would bear aviation hazard navigation lights, but no downward-focused lighting. 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 no impact on finfish, invertebrates, and EFH.

The Draft EIS also did not consider noise from G&G surveys because it was previously assumed that the Proposed Action would not lead to impacts from G&G surveys; however, BOEM now considers the possibility of direct and indirect impacts resulting from G&G surveys used to inspect the cables after installation, as well as from pre-construction surveys associated with other projects. Noise from G&G surveys may occur during the Proposed Action. G&G noise can disturb finfish and invertebrates in the immediate vicinity of the survey and can cause temporary behavioral changes. Impacts on finfish, invertebrates, and EFH are anticipated to be negligible.

Finally, the Draft EIS also did not describe how the presence of structures could result in hydrodynamic disturbances or potentially affect migration. BOEM has included these sub-IPFs in response to public comments received on the Draft EIS. The natures of these sub-IPFs and of their impacts on finfish, invertebrates, and EFH are described in detail in Section 3.4.1.1. The Proposed Action could result in up to 102 foundations and 152 acres (0.6 km^2) of scour/cable protection that could influence hydrodynamics and/or migration in the manner discussed above. Considering that such impacts are anticipated to be highly localized and to vary seasonally, and that the Proposed Action would involve no more than 102 foundations, these impacts would likely be negligible.

Changes to the design capacity of the turbine to be used would not alter the maximum potential impacts on finfish, invertebrates, and EFH for the Proposed Action and all other action alternatives because the maximum-case scenario involved the maximum number of WTGs (100) allowed in the PDE. Changes to the design of the substation would also not alter the potential impacts on finfish, invertebrates, and EFH for the Proposed Action and all other action alternatives because the substation site is on land and would have no impact on finfish, invertebrates, and EFH.

The cumulative impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are listed by IPF in Table 3.4-1. The natures of the primary IPFs and of potential impacts on finfish, invertebrates, and EFH are described in detail in Section 3.4.1.1. Under the No Action Alternative, BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities other than the Proposed Action to have continuing temporary to permanent impacts on finfish, invertebrates, and EFH, primarily through the following IPFs: resource exploitation, regulated fishing effort, bycatch, G&G survey noise, pile-driving noise, new cable emplacement, the presence of structures, and climate change.

The cumulative impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities would be of the similar types described in Section 3.4.1.1, but may differ in intensity and extent. It is assumed that the energy demand that the Vineyard Wind 1 Project would fill (if approved) would likely be met by other projects in remaining areas of the Massachusetts, Rhode Island, and/or New York leases (if not approved). Although the impacts from a substitute project may differ in location and time, depending on where and when offshore wind facilities are developed to meet the remaining demand, the nature of impacts and the total number of WTGs would be similar either with or without the Proposed Action, as described in Section 3.4.1. In other words, future offshore wind facilities capable of generating 9,404 MW would be built in the RI and MA Lease Areas, although, in the absence of the Proposed Action, none would be built before 2021.

Accidental releases: The negligible incremental impact of the Proposed Action would not increase the risk of accidental releases beyond the risk under the No Action Alternative. Cumulatively, the risk of impacts on finfish, invertebrates, and EFH due to accidental releases of invasive species could be major if the invasive species become(s) established and out-compete(s) native fauna. However, the greatest source of risk comes from ongoing activities, with offshore wind contributing only a small amount of increased vessel traffic from overseas ports. The cumulative impacts of other types of accidental releases would be highly similar to the impacts under the No Action Alternative and would be negligible to minor.

Anchoring: The minor incremental impact of anchoring on 4.4 acres (17,806 m^2) in the Proposed Action would not increase the impacts of anchoring beyond the approximately 276 acres (1.1 km^2) of impacts under the No Action Alternative. According to the assumptions stated in Section 3.4.1.1, the amount of anchoring disturbance in the Proposed Action does not add to the amount of anchoring disturbance under the No Action Alternative, but rather it preempts an equal amount that might otherwise have occurred at a later time. Cumulative impacts of this IPF on finfish, invertebrates, and EFH associated with the Proposed Action and past, present, and reasonably foreseeable activities are anticipated to be minor. All impacts would be localized, turbidity would be temporary, and mortality from direct contact would be recovered in the short term. Degradation of sensitive habitats, if it occurs, could be long-term. The Proposed Action would not anchor in eelgrass.

EMF: The negligible to minor incremental impact of the Proposed Action would not increase the impacts of EMF beyond the impacts under the No Action Alternative. Therefore, cumulative impacts associated with the Proposed Action and past, present, and reasonably foreseeable activities would be highly similar to the impacts under the No Action Alternative and would be negligible to minor. As described in Section 3.4.1.1, EMF from multiple cables would not overlap even for multiple cables within a single OECC.

Light: The negligible incremental impact of the Proposed Action would not noticeably increase the impacts of light beyond the impacts under the No Action Alternative. Therefore, cumulative impacts associated with the Proposed Action and past, present, and reasonably foreseeable activities would be highly similar to the impacts under the No Action Alternative and would be negligible, mostly attributable to ongoing activities.

New cable emplacement/maintenance: The Proposed Action's moderate incremental impact of up to 328 acres (1.3 km^2) of seafloor disturbed by cable installation and up to 69 acres (0.3 km^2) affected by dredging prior to cable installation would not increase the total impact(s) of all cable installation activities, including offshore wind activities, that occur within the geographic analysis area for finfish, invertebrates, and EFH because, according to the assumptions stated in Section 3.4.1.1, the amount of new cable in the Proposed Action does not add to the amount of new cable under the No Action Alternative, but rather it preempts an equal amount that might otherwise have occurred at a later time. In most locations, the affected areas are expected to recover naturally, and impacts would be short-term because seabed scars associated with jet plow cable installation are expected to recover in a matter of weeks, allowing for rapid recolonization (MMS 2009, Appendix H). Suspended sediment concentrations during activities other than dredging would be within the range of natural variability for this location. The cumulative impacts of this IPF on finfish, invertebrates, and EFH associated with the Proposed Action and past, present, and reasonably foreseeable activities are anticipated to be moderate. Any dredging necessary prior to cable installation could also contribute additional impacts.

Noise: The negligible to minor incremental impacts of the Proposed Action would not increase the impacts of noise beyond the impacts under the No Action Alternative (minor to moderate). Therefore, cumulative impacts associated with the Proposed Action and past, present, and reasonably foreseeable activities would be highly similar to the impacts under the No Action Alternative and would be minor to moderate.

Port utilization: Because the Proposed Action would cause no change in port utilization, no cumulative impacts of this IPF on finfish, invertebrates, and EFH can be attributed to the Proposed Action, although ongoing and future activities, including other offshore wind projects, are expected to cause impacts.

Presence of structures: The various types of impacts on finfish, invertebrates, and EFH that could result from the presence of structures, such as entanglement and gear loss/damage, hydrodynamic disturbance, fish aggregation, habitat conversion, and migration disturbances, are described in detail in Section 3.4.1.1. The negligible to moderate incremental impacts of the Proposed Action would not increase the impacts beyond those of the No Action Alternative. Cumulatively, using the assumptions in Appendix A, there could be up to approximately 1,221 acres (4.9 km^2) of new hard protection atop cables. Of this area, 98 acres (0.4 km^2) would result from the Proposed Action, and the remainder is the estimated result of other offshore wind projects in the geographic analysis area for finfish, invertebrates, and EFH. The total soft bottom area that would be modified is less than 0.002 percent of available soft bottom in the geographic analysis area for finfish, invertebrates, and EFH. The cumulative number of foundations, the amount of scour protection, and the amount of cable protection would be the same under the Proposed Action and under the No Action Alternative. The structures and the consequential impacts would remain at least until decommissioning of each facility is complete. Considering the above information, the cumulative impacts of this IPF on finfish, invertebrates, and EFH associated with the Proposed Action and past, present, and reasonably foreseeable activities are anticipated to include moderate impacts and possibly moderate beneficial impacts.

Regulated fishing effort: Regulated fishing effort can affect finfish, invertebrates, and EFH by modifying the nature, distribution, and intensity of fishing-related impacts (mortality, bottom disturbance). The Proposed Action and other future offshore wind development could indirectly influence this IPF (Section 3.11), possibly indirectly influencing when, where, and to what degree fishing activities affect finfish, invertebrates, and EFH. See Section 3.11.2 for the cumulative contribution of ongoing, future non-offshore wind, future offshore wind other than the Proposed Action, and the Proposed Action on regulated fishing effort. 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 likely qualify as moderate.

Seabed profile alterations: The minor incremental impacts of the Proposed Action would not increase the impacts beyond those of the No Action Alternative because, according to the assumptions stated in Section 3.4.1.1, the 69 acres (0.3 km^2) of dredging in the Proposed Action does not add to the amount of dredging under the No Action Alternative, but rather it preempts an equal amount that might otherwise have occurred at a later time. Although the amount of seabed profile alteration in the No Action Alternative is not known, it is likely to be on the order of 20 times more than the Proposed Action. The cumulative impacts of this IPF on finfish, invertebrates, and EFH associated with the Proposed Action and past, present, and reasonably foreseeable activities are also anticipated to be minor.

Sediment deposition and burial: The minor incremental impacts of the Proposed Action would not increase the impacts beyond those of the No Action Alternative because, according to the assumptions stated in Section 3.4.1.1, the approximately 2,594 acres [10.5 km^2] subject to sediment deposition in the Proposed Action does not add to the amount of sediment deposition under the No Action Alternative, but rather it preempts an equal amount that might otherwise have occurred at a later time. Although the amount of sediment deposition in the No Action Alternative is not known, it is likely to be on the order of 20 times more than the Proposed Action. The cumulative impacts of this IPF on finfish, invertebrates, and EFH associated with the Proposed Action and past, present, and reasonably foreseeable activities are also anticipated to be minor.

Climate change: This IPF would contribute to the reduced growth or decline of invertebrates that have calcareous shells, alterations in migration patterns, and increased disease frequency. Because this IPF is a global phenomenon, the cumulative impacts through this IPF would be the same as those under the No Action Alternative. The intensity of impacts resulting from climate change are uncertain, but are anticipated to qualify as minor to moderate.

Other considerations: For temporary impacts, including the effects of pile-driving noise and the temporary disturbance caused by anchoring, it is likely that a portion, possibly the majority, of such impacts from future activities would not overlap in time with the temporary impacts of the Proposed Action. However, some IPFs that can cause temporary impacts can also cause long-term to permanent impacts.

The endangered Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) may be affected by the Proposed Action. Consistent with the analysis in BOEM's BA for the Proposed Action (BOEM 2019b), all the IPFs and impacts on finfish and EFH discussed above could also apply to the Atlantic sturgeon. Individuals from the five distinct population segments of ESA-listed Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) may be affected by the Proposed Action, although BOEM does not anticipate that any Atlantic sturgeon will be seriously injured or killed as a result of exposure to any IPF. The most significant IPF for individual sturgeon is likely to be noise from pile driving; however, even considering the cumulative impacts scenario, effects to individual Atlantic sturgeon are expected to be limited to temporary behavioral disturbance. As such, the Proposed Action and ongoing and reasonably foreseeable actions are not anticipated to result in adverse population consequences.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from negligible to moderate and moderate beneficial. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action and past, present, and reasonably foreseeable activities would result in moderate impacts on finfish, invertebrates, and EFH in the analysis area. The main drivers for this impact rating are fishing mortality, climate change, ongoing recurring bottom disturbance from bottom-tending fishing gear, and direct 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). BOEM has considered the possibility of a major impact resulting from invasive species; this level of impact could occur if an invasive species were to adversely impact ecosystem health or habitat quality at a regional scale. While it is an impact that should be considered, it is also unlikely to occur. Invasive species have already been documented on Georges Bank, and the risk of impacts within the analysis area would be highly similar under the No Action Alternative or under the Proposed Action, as ongoing activities (e.g., shipping and marine debris) contribute most of the risk through this IPF. Thus, the overall cumulative impacts on finfish, invertebrates, and EFH would likely qualify as moderate because a notable and measurable impact is anticipated, but the resource would likely recover completely when the impacting agent were gone and remedial or mitigating action were taken.

3.4.2.2. Cumulative Impacts of Alternative B, C, D1, D2, and E

The direct and indirect impacts of Alternatives B, C, D1, D2, or E on finfish, invertebrates, and EFH are described in the Draft EIS Section 3.3.6. The impacts under Alternatives B, C, D1, D2, or E would differ from those under the Proposed Action only in the direct and indirect impacts of the proposed Project; the cumulative impact contributions from past, present, and reasonably foreseeable activities would be the same under any alternative. The direct and indirect impacts of Alternative B would be similar to, but slightly less than, those of the Proposed Action because impacts on the Lewis Bay shellfish beds and sensitive life stages of finfish and shellfish would be avoided, and the OECC would be approximately 9 percent shorter under Alternative B than under the maximum-case scenario of the Proposed Action using the New Hampshire Avenue landfall site. According to the results of the sediment dispersion model (Epsilon 2018a), deposition of 0.04 to 0.2 inch (1 to 5 millimeters) of sediment could potentially occur on up to 2,248 acres (9.1 km^2), while deposition of more than 0.2 inch (5 millimeters) would be limited to 91 acres (0.4 km^2) along the western OECC to the Covell's Beach landfall site. In other respects, the incremental impacts of Alternative B on finfish, invertebrates, and EFH would be similar to those of the Proposed Action.

The direct and indirect impacts of Alternative C would be very similar to those under the Proposed Action (Draft EIS Section 3.3.6.5). The direct and indirect impacts of Alternatives D1 and D2 on finfish, invertebrates, and EFH would be similar to, but slightly greater than, those of the Proposed Action due to an increase in inter-array cable (Draft EIS Section 3.3.6.6). Recent forecasts by Vineyard Wind estimate that the length of inter-array cabling would be approximately 186.4 miles (300 kilometers) under Alternative D1 or D2, which exceeds the maximum design parameter in the COP PDE of 171 miles (275 kilometers). The direct and indirect impacts of Alternative E would be less than those of the Proposed Action because IPFs associated with the installation of WTGs, including pile-driving noise, temporary habitat disturbance, turbidity, and sediment deposition, would be reduced by approximately 16 percent compared to the maximum-case scenario under the Proposed Action (Draft EIS Section 3.3.6.7). However, the level of impact on finfish, invertebrates, and EFH under Alternative E would still be of a similar level to that of the Proposed Action. Overall, the direct and indirect impacts of Alternative B, C, D, or E on finfish, invertebrates, and EFH would likely be minor to moderate, including the presence of structure, which may result in moderate beneficial impacts, as described in Section 3.4.2.1.

While Alternatives B and E may be slightly less impactful to finfish, invertebrates, and EFH than the Proposed Action and Alternative D may be slightly more impactful than the Proposed Action, the cumulative impacts under Alternative B, C, D, or E would be similar to the cumulative impacts under the Proposed Action (with individual IPFs leading to impacts ranging from negligible to moderate and moderate beneficial). The overall cumulative impacts of Alternative B, C, D, or E when combined with past, present, and reasonably foreseeable activities on finfish, invertebrates, and EFH would be of the same level as under the Proposed Action—moderate. This impact rating is driven mostly by ongoing activities, such as fishing mortality, climate change, and bottom-tending fishing gear, as well as by the construction, installation, and presence of other offshore wind structures.

3.4.2.3. Direct, Indirect, and Cumulative Impacts of Alternative F

Alternative F analyzes a vessel transit lane through the WDA, in which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The WTGs that would have been located within the transit lane would not be eliminated from the Proposed Action; instead, the displaced WTGs would be shifted to locations south within the Lease Area. Under this alternative, BOEM is analyzing a 2- and 4-nautical-mile northwest/southeast vessel transit lane through the WDA combined with any action alternative; however, this analysis focuses on the combination of Alternative F with either the Proposed Action or Alternative D2 layout. Therefore, the number of turbines would remain the same. The northern transit lane within the WDA could result in the relocation of 16 to 34 WTG placements, an increased extent of inter-array cables, and a 12 to 61 percent increase in the size of the WDA, depending on whether the Proposed Action or Alternative D2 layout is used and how wide the transit lane is.

The direct and indirect impacts of Alternative F on finfish, invertebrates, and EFH would be greater than those of the Proposed Action because the length of inter-array cabling would increase and would likely exceed the maximum design parameter in the COP PDE of 171 miles (275 kilometers) due to the need to traverse a 2- or 4-nautical-mile transit lane; the seafloor area affected in the course of inter-array cable installation and operations and maintenance would also increase. Recent forecasts by Vineyard Wind estimate that the length of inter-array cabling would be approximately 221 miles (355 kilometers) under Alternative F with a 4-nautical-mile transit lane and the Proposed Action layout, and 234 miles (376 kilometers) with a 4-nautical-mile transit lane and the Alternative D2 layout; if the transit lane were only 2 nautical miles wide, the length of inter-array cabling would still exceed that in the COP PDE but would be somewhat less than with a 4-nautical-mile transit lane. Additional site characterization surveys may cause local temporary impacts that are difficult to detect. Slight changes in finfish and invertebrate communities could occur with changing location and depth of proposed Project impacts in a different portion of the lease area, but BOEM anticipates these changes to be insignificant, based on the similarity of sediments and invertebrate communities across the WDA (COP Volume II, Appendix H-4; Epsilon 2018a). Therefore, expanding the WDA and shifting some activities and structures to the south/southwest would not likely affect different finfish, invertebrates, and EFH or change the nature of potential impacts on finfish, invertebrates, and EFH. For the same reason, the potential impacts on finfish, invertebrates, and EFH of Alternative F do not depend on the other turbine layout constraints (Proposed Action, Alternative D2, or any other alternative) or on the width of the transit lane (2 nautical miles or 4 nautical miles), with the exception that a greater amount of cable would lead to greater impacts. While Vineyard Wind would have the liberty to configure the inter-array and inter-link cables within the bounds established by the final approved COP, the minimum cable length technically necessary to connect enough WTGs to meet the 800 MW generation capacity in the COP (and thus, the impacts of the cable on finfish, invertebrates, and EFH) would likely be shortest for a 2-nautical-mile transit lane combined with the layout of the Proposed Action (or Alternative B or Alternative E) and the longest for a 4-nautical-mile transit lane combined with the layout of Alternative D2. Overall, the direct and indirect impacts of Alternative F on finfish, invertebrates, and EFH would likely be minor to moderate, including the presence of structure, which may result in moderate beneficial impacts.

Because the transit lanes are generally not oriented to existing fishing patterns, it is not anticipated that there would be an increase in the utilization of bottom-tending fishing gear in the transit lane. Thus, the difference in commercial fishing pressure between Alternative F and the Proposed Action would likely be biologically insignificant in relation to existing commercial fishing harvest regionally.

In considering the cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities, BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The cumulative impacts of Alternative F would be similar to the cumulative impacts under the Proposed Action (with individual IPFs leading to impacts ranging from negligible to moderate and moderate beneficial). The overall cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities on finfish, invertebrates, and EFH would be of the same level as under the Proposed Action—moderate. The width of the transit lane and the other alternative(s) which Alternative F is combined could slightly modify the amount of cumulative impacts by modifying the amount of incremental impact, as discussed above; however, the overall level of cumulative impacts would be similar for any contemplated version of Alternative F (moderate), which is driven mostly by ongoing activities, such as fishing mortality, climate change, bottom-tending fishing gear, as well as by the construction, installation, and presence of other offshore wind structures.

BOEM has qualitatively evaluated the cumulative impacts of implementing all six RODA-recommended transit lanes, including the northern transit lane described for Alternative F, as well as five other transit lanes through the RI and MA Lease Areas. To the extent additional transit lanes are implemented in the future outside of the WDA as part of RODA's suggestion, the WTGs for future offshore wind projects may need to be located further from shore, similar to the proposed Project under Alternative F. As a result, establishment of additional transit lanes could require increased lengths of offshore export cable and therefore effects to finfish, invertebrates, and EFH. This could result in some activities that are uncertain and may lead to greater, lesser, or similar impacts on finfish, invertebrates, and EFH. If all the proposed transit lanes were implemented, this would not allow the technical capacity of offshore wind power generation assumed in Chapter 1 to be met. Specifically, assuming that all WTGs would be of 12-MW capacity, then an estimated 800 foundations (784 WTGs and 16 ESPs) within the RI and MA Lease Areas would be required to meet the offshore energy demand.[3] Cumulatively with implementation of all six transit lanes with 4-nautical-mile transit lanes and a 1- by 1-nautical-mile WTG layout would only allow space for a maximum of 736 foundations. If in the future all six transit lanes were implemented with 2-nautical-mile width and/or the Proposed Action layout, there may not be enough space to develop power generation capacity to meet demand in Massachusetts, Rhode Island, and New York. Therefore, cumulative impacts under this scenario would likely fall somewhere between the cumulative impacts of the Proposed Action (or of Alternative D2) and the cumulative impacts of Alternative F with 4-nautical-mile transit lanes and the proposed Project layout per Alternative D2.

3.4.2.4. Comparison of Alternatives

As discussed in the Draft EIS Section 3.3.6.9, the direct and indirect impacts associated with the Proposed Action do not change substantially under Alternatives B through E. Although the amount of impacts from cabling varies slightly among alternatives, the overall level of direct and indirect impacts would be similar for all action alternatives (**minor** to **moderate**, including the presence of structure, which may result in **moderate beneficial** impacts). Ultimately, the same construction, operations and maintenance, and decommissioning activities would still occur, albeit at a reduced scale in some cases. Alternative B would avoid Lewis Bay, thus avoiding impacts on shellfish beds and sensitive life stages of finfish and shellfish in that location, and would reduce impacts proportional to the length of the OECC by approximately 9 percent compared to the maximum-case scenario under any other action alternative. Alternative E would reduce impacts related to the number of WTGs by approximately 16 percent compared to the maximum-case scenario under any other action alternative; it is important to note that not all impacts are related to the number of WTGs, and thus the total impact would be reduced by less than 16 percent; it is also important to note that Alternative E would reduce the potentially beneficial impacts as well as reduce the impacts. Alternative F, not contemplated in the Draft EIS, would have direct and indirect impacts on finfish, invertebrates, and EFH that would be greater than those of the Proposed Action because the length of inter-array cabling would increase.

BOEM has considered Alternatives B, C, D, E, and F in an attempt to reduce conflicts with commercial fishing; these alternatives could indirectly expose commercially important finfish and invertebrates to harvest in areas where they otherwise might experience less commercial fishing pressure from mobile gears under the Proposed Action. Although fishing pressure is a very important factor affecting finfish and invertebrates and fishing pressure may be substantially influenced by the presence of structures offshore, the difference in commercial fishing pressure among alternatives is anticipated to be biologically insignificant in relation to existing commercial fishing pressure regionally.

Cumulative impacts under any action alternative would likely be similar because the majority of the cumulative impacts result from ongoing activities and other future offshore wind projects. However, the differences in incremental impacts between action alternatives should still be considered alongside the impacts of other ongoing and future activities. Therefore, cumulative impacts on finfish, invertebrates, and EFH would be slightly lower under Alternative B or Alternative E than under the maximum-case scenario in any other action alternative (other than Alternative F), although, under any alternative, the level of individual impacts would range from **negligible** to **moderate** and **moderate beneficial** and the overall cumulative impact would be **moderate**. The cumulative impacts on finfish, invertebrates, and EFH under Alternative F would likely qualify as **moderate**.

In conclusion, the overall level of cumulative impacts on finfish, invertebrates, and EFH from any alternative, including the No Action Alternative, when combined with past, present, and reasonably foreseeable activities would be **moderate**. Cumulatively, fishing mortality, climate change, and bottom-tending fishing gear, as well as the construction, installation, and presence of offshore wind structures would lead to noticeable temporary and permanent adverse impacts across much of the geographic analysis area. The presence of new structures could benefit some fish and invertebrate communities that depend on hard structure.

3.5. MARINE MAMMALS

3.5.1. No Action Alternative Impacts

Table 3.5-1 contains a detailed summary of baseline conditions and the anticipated impacts of ongoing and future offshore activities other than offshore wind on marine mammals, based on the IPFs assessed. This information comes primarily from the Draft EIS, supplemented by information developed in response to comments on the Draft EIS, from NOAA, and additional information. The impact analysis is limited to the impacts within the geographic analysis area for marine mammals, as described in Table A-1 and on Figure A.7-5 in Appendix A.

Marine mammals in the geographic analysis area are subject to a variety of ongoing human-caused impacts, including collisions with vessels (ship strikes), whaling/hunting, entanglement with fishing gear, anthropogenic noise, pollution, disturbance of marine and

[3] If the WTG sizes specified in Appendix A are assumed, a total of 975 foundations would be required.

coastal environments, effects on benthic habitat, accidental fuel leaks or spills, waste discharge, and climate change. Many marine mammal migrations cover long distances, and these factors can have impacts on individuals over broad geographical scales. Entanglement in fishing gear is a substantial ongoing threat to marine mammals. Fisheries interactions are likely to have demographic effects on marine mammal species, with estimated global mortality exceeding hundreds of thousands individuals each year (Read et al 2006; Reeves et al 2013; Thomas et al. 2016). In the Atlantic, bycatch occurs in various gillnet and trawl fisheries in New England and the Mid-Atlantic Coast, with "hotspots driven by marine mammal density and fishing intensity (Lewiston et al. 2014; NMFS 2018). Entanglement in fishing gear has been identified as one of the leading causes of mortality in North Atlantic right whales (*Eubalaena glacialis*, NARW), and may be a limiting factor in the species recovery (Knowlton et al. 2012). Entanglement may also be responsible for high mortality rates in other large whale species (Read et al. 2006). Additionally, bottom trawling and benthic disruption have the potential to result in impacts on prey availability and distribution. These ongoing impacts on marine mammals, especially fisheries interactions, would continue regardless of the offshore wind industry.

Under the No Action Alternative, the proposed Project would not be built, and would not result in any marine mammal impacts. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. If the Vineyard Wind 1 Project were not approved, then the impacts from the proposed Project would not occur as proposed. However, the state demand that the Vineyard Wind 1 Project would have filled, if approved, could likely be met by other projects in the geographic analysis area for marine mammals. Therefore, the impacts on marine mammals would be similar, but the exact impact would not be the same due to temporal and geographical differences. The analysis that follows includes the full scope of the cumulative scenario specific to the geographic analysis area for marine mammals, and considers the assumptions included in Section 1.2 and Appendix A. A detailed analysis of impacts associated with future offshore wind development is provided in Section 3.5.1.1 and summarized in Table 3.5-1. Cumulative impacts of the Proposed Action and action alternatives are analyzed in Section 3.5.2.

3.5.1.1. Future Offshore Wind Activities (without Proposed Action)

BOEM expects these future offshore wind development activities would affect marine mammals through the following primary IPFs.

Accidental releases: Accidental releases of fuel, fluids, hazmat, and/or trash and debris may increase as a result of future offshore wind activities. Section 3.1.2 discusses the nature of releases anticipated. The risk of any type of accidental release would be increased primarily during construction when additional vessels are present, but also during operations and decommissioning of offshore wind facilities.

In the expanded cumulative scenario, Table A-4 in Appendix A, there would be a low risk of a leak of fuel, fluids, and/or hazardous materials from any single one of approximately 2,021 WTGs, each with approximately 5,000 gallons (18,927 liters) stored. Total fuel, fluids, and/or hazardous material within the geographic analysis area would be approximately 13.1 million gallons (49.6 million liters). According to BOEM's modeling (Bejarano et al. 2013), a release of 128,000 gallons (484,532.7 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 likelihood of a spill occurring from multiple WTGs and ESPs 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 the individual fitness, including adrenal effects, hematological effects, liver effects lung disease, poor body condition, skin lesions, and several other health affects attributed to oil exposure (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008, Smith et al. 2017; Sullivan et al. 2019; Takeshida et al. 2017). Additionally, accidental releases may result in impacts on marine mammals due to effects to prey species (Table 3.4-1). Based on the volumes potentially involved, the likely amount of additional releases associated with future 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. BOEM assumes operator compliance 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 project areas. Worldwide 62 of 123 (about 50 percent) marine mammal species have been documented ingesting marine litter (Werner et al. 2016). Stranding data indicate potential debris induced mortality rates of 0 to 22 percent. Mortality has been documented in cases of debris interactions, as well as blockage of the digestive track, disease, injury, and malnutrition (Baulch and Perry 2014). However, it is difficult to link physiological effects to individuals to population level impacts (Browne et al. 2015). While precautions to prevent accidental releases will be employed by vessels and port operations associated with future 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. In the event of a release, it would be an accidental, low probability event in the vicinity of project areas or the areas from ports to the project areas used by vessels.

EMF: Marine mammals appear to have a detection threshold for magnetic intensity gradients (i.e., changes in magnetic field levels with distance) of 0.1 percent of the earth's magnetic field or about 0.05 microtesla (μT) (Kirschvink 1990) and are thus likely to be very sensitive to minor changes in magnetic fields (Walker et al. 2003). There is a potential for animals to react to local variations of the geomagnetic field caused by power cable EMFs. Depending on the magnitude and persistence of the confounding magnetic field, such an effect could cause a trivial temporary change in swim direction or a longer detour during the animal's migration (Gill et al. 2005). Such an effect on marine mammals is more likely to occur with direct current cables than with AC cables (Normandeau et al. 2011). In the expanded cumulative scenario, Table A-4 in Appendix A, up to 5,947 miles (9,571 kilometers) of cable would be added in the geographic analysis area, producing EMF in the immediate vicinity of each cable during operations. Submarine power cables in the geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF resulting from cable operation to low levels. Marine mammals have the potential to react to submarine cable EMF; however, this impact, if any, would be limited to extremely small portions of the areas used by migrating marine mammals. As such, exposure to this IPF would be low; as a result, impacts such as changes in swimming direction and altered migration routes would not be expected to biologically significant.

New cable emplacement and maintenance activities: The impact on water quality from sediment suspension during cable-laying activities is expected to be temporary and short-term. Using the assumptions in Table A-4 in Appendix A, the total area of seafloor disturbed by cable emplacement for offshore wind facilities is estimated to be up to 8,153 acres (33 km^2) beginning in 2022 and continuing through 2030. In addition to cables related to individual offshore wind facilities, two unsolicited proposals for the development of two open access offshore transmission systems have been announced. The routes for these proposed regional cables have not been determined at this time and are not considered reasonably foreseeable, but BOEM assumes that if future offshore wind projects utilize one of these open-access transmission systems, the impacts associated with new cable emplacement and maintenance activities would be less than if each individual project installed its own cable. Data are not available regarding marine mammal avoidance of localized turbidity plumes; however, Todd et al. (2015) suggest that since some marine mammals often live in turbid waters and some species of mysticetes and sirenians employ feeding methods that create sediment plumes, some species of marine mammals have a tolerance for increased turbidity. Similarly, McConnell et al. (1999) documented movements and foraging of grey seals in the North Sea. One tracked individual was blind in both eyes, but otherwise healthy. Despite being blind, observed movements were typical of the other study individuals, indicating that visual cues are not essential for grey seal foraging and movement (McConnell et al. 1999). If elevated turbidity caused any behavioral responses such as avoiding the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any impacts would be short-term and temporary. Turbidity associated with increased sedimentation has some potential to result in temporary, short-term impacts on marine mammal prey species. While the cable routes for future offshore wind developments are unknown at this time, the areas subject to increased suspended sediments from simultaneous activities would be limited and all impacts would be localized and temporary. Sediment plumes would be present during construction for 1 to 6 hours at a time. Any dredging necessary prior to cable installation could also contribute additional impacts. Given that impacts would be temporary and generally localized to the emplacement corridor, no individual fitness or population-level effects on marine mammals would be expected (NOAA 2020). Based on the current anticipated construction schedule provided in Table A-6 in Appendix A, construction impacts associated with multiple projects could overlap in time and space and could potentially result in greater impacts, though no individual fitness or population-level impacts would be expected to occur because marine mammals do not appear to be affected by increased turbidity and would be expected to be able to successfully forage in adjacent areas not affected by sediment plumes (NOAA 2020).

Noise: There are several intrinsic, extrinsic, and ecological drivers that can result in cumulative impacts on individuals and populations. Underwater noise can be characterized as an extrinsic factor, which is a factor in an animal's external environment that creates stress in an animal (Roberts 2016). Anthropogenic noise on the OCS associated with the future offshore wind development, including noise from project aircraft, G&G surveys, vessel traffic, operational WTGs, and pile driving has the potential to result in impacts on marine mammals foraging, orientation, migration, predator detection, social interactions, or other activities (Southall et al. 2007).Future offshore wind development may require the use of helicopters to supplement crew transport during construction and operations. BOEM expects that helicopters transiting to the offshore WDAs would fly at altitudes above those that would cause behavioral responses from marine mammals except when flying low to inspect WTGs or take off and land on the service operations vessel (SOV). Noise associated with helicopter and/or aircraft use during construction and operations of future offshore wind development may result in some short-term and temporary non-biologically significant behavioral responses, including short surface durations, abrupt dives, and percussive behaviors (i.e., breaching and tail slapping) (Patenaude et al. 2002). If a listed whale is located within 820 to 1,181 feet (250 to 360 meters) of the helicopter, it is possible that behavior responses may occur, but they are expected to be temporary and short-term. NARW approach regulations (50 CFR 222.32) prohibit approaches within 1,500 feet (500 yards). BOEM will require all aircraft operations to comply with current approach regulations for any sighted NARWs or unidentified large whale. While helicopter traffic may cause some temporary and short-term behavioral reactions in marine mammals while helicopters move to a safe distance, BOEM does not expect exposure to aircraft noise to result in injury to any marine mammals. Similarly, aircraft have the potential to disturb hauled out seals if aircraft overflights occur within 2,000 feet (610 meters) of a haul out area. However, this disturbance would be temporary and short-term, with individuals seeking refuge in the water for a few minutes to a few hours (Southall et al. 2007).

Without mitigation, certain types of G&G surveys have the potential to result in long-term, high intensity impacts on marine mammals, including auditory injuries, stress, disturbance, and behavioral responses, if present within the ensonified area. However, G&G noise resulting from offshore wind site characterization surveys is of less intensity than the acoustic energy characterized by seismic airguns and affects a much smaller area than G&G noise from seismic airgun surveys typically associated with oil and gas exploration. While seismic airguns are not used for offshore wind site characterization surveys, sub-bottom profiler technologies that are hull-mounted on survey vessels may have the potential to incidentally harass marine mammals and would be required to follow mitigation and monitoring measures. Typically, mitigation and monitoring measures are required by BOEM through requirements of lease stipulations and required by ITAs from NOAA Fisheries pursuant to Section 101(a)(5) of the MMPA. Mitigation and monitoring measures will lower the stock-level effects of the take of any marine mammals to negligible levels, as required by the MMPA, including potential for adverse behavioral responses and auditory injury (permanent threshold shift/temporary threshold shift [PTS/TTS]). Similarly, the requirement to comply with avoidance and minimization measures for these surveys would avoid any effects on individuals that could result in population-level effects to threatened and endangered populations listed under the ESA. These measures may include, but are not limited to, seasonal restrictions, protected species observers (PSOs), passive acoustic monitoring (PAM), pre-survey monitoring, and the establishment of exclusion zones in which sound sources will be shut down when marine mammals are present.

The following analysis assesses the impacts of pile-driving activities associated with offshore wind facilities on marine mammals under the cumulative impact scenario. The greatest potential for impact from noise exposure is likely to be caused by pile driving due to relatively high sound pressure levels (SPLs) associated with this activity. The installation of WTG foundations into the seabed involves impact pile driving, which produces high SPLs in both the surrounding air and underwater environment. Sound levels may vary depending on the size of the hammer, diameter of the pile, properties of the seabed, and other environmental factors. This noise would be produced intermittently during construction of each project for approximately 2 to 3 hours per foundation or 4 to 6 hours per day for the installation of 2 foundations per day. Cumulatively, construction is expected to occur intermittently over a 6- to 10-year period in lease areas that are anticipated to be developed on the Atlantic OCS. In the expanded cumulative scenario (Table A-4 in Appendix A), construction of 2,066 offshore structures between 2022 and 2030 will result in temporary increases in noise that may impact marine mammals. Depending on their distribution in relation to construction activities and the timing of that construction, the duration and frequency of any exposure of marine mammals to construction noise will be variable. An individual may be exposed to anywhere from a single pile driving event (lasting no more than a few hours on a single day), to intermittent noise over a period of weeks if an individual travels over the larger geographic analysis area where pile driving may be occurring. The potential effects of exposure to pile-driving noise range from minor, temporary behavioral disturbance with no biological consequences to auditory injury. As explained above, the use of measures to mitigate exposure is expected to reduce the potential for injury and most individuals are expected to only be exposed to noise that would result in recoverable auditory injuries and behavioral impacts. The probability and extent of potential impacts are situational and are dependent on several factors including pile size, impact energy, duration, site characteristics (i.e., water depth, sediment type), time of year, and species, among others that have been considered in the acoustic exposure modeling.

Impacts on marine mammals arising from pile-driving activities could occur under three different scenarios (Table A-4 in Appendix A):

- Concurrent pile driving associated with neighboring projects;
- Non-concurrent pile driving in the same year; and
- Multi-year pile driving (concurrent or non-concurrent).

A limited amount of concurrent pile driving at neighboring projects is anticipated in the cumulative impact scenario. The RI and MA Lease Areas have the greatest potential for concurrent pile driving to occur. The total number of possible concurrent construction days ranges from 16 to 103 days under the 1 foundation per day scenario and 8 to 52 days of pile driving under the 2 foundations per day scenario, depending on the year (Table 3.5-2). The Delaware/Maryland Lease Areas have a potential for 11 days of concurrent pile driving in 2022. An individual marine mammal present in either of these areas on those days could be exposed to the noise from more than one pile driving event per day, repeated over a period of days. Concurrent pile driving could occur for one or more projects on the same day. Concurrent pile driving increases the daily amount of noise exposure in an area but decreases the total number of days of exposure in the same area. Concurrent pile driving occurring within the same 24-hour period would extend the exposure period and create a greater impact area(s) in which marine mammals could be exposed to noise that may cause PTS or behavioral impacts. The number of foundations for each project is the primary factor determining the maximum number of overlapping pile-driving days from neighboring projects. One foundation installed per day results in the maximum-case scenario for the greatest number of overlapping pile-driving days for neighboring projects. Individual marine mammals are not likely to be exposed to concurrent pile-driving days on non-neighboring projects because the distances separating leases in the different regions results in an unlikely potential of exposure to noise between two areas in a 24-hour period.

Non-concurrent pile driving in the same year would potentially result in the exposure of an individual marine mammal to pile driving noise on multiple days over the same year but not necessarily in the same geographic area. Non-concurrent pile driving associated with neighboring projects could occur when pile driving does not overlap and occurs on different days. Non-concurrent pile driving potentially decreases the daily amount of noise exposure in an area from neighboring projects but increases the total number of days of exposure in the same area. A pile-driving scenario with project construction occurring on different days would result in the greatest number of exposure days. If project construction is timed to not overlap and occurs on separate days, the number of non-concurrent days of pile driving in any given year is greater than the concurrent pile-driving scenario.

Finally, as pile driving is anticipated to occur over multiple years (2022 to 2030), individuals may be exposed to pile-driving noise across multiple years (concurrent or non-concurrent) and in the same or different geographic areas. Cumulatively, pile driving may be occurring up to 4.4 percent of the time over this period under the maximum-case scenario for non-concurrent pile driving where an individual could be exposed to pile driving in each geographic analysis area. For this scenario to occur, the timing of pile driving would need to co-occur with the movements of an individual whale over the course of a year through each geographic analysis area. Under such a scenario, a marine mammal could be intermittently exposed to pile driving noise for up to 6 consecutive years, from one or more projects, if no mitigation measures were implemented.

Marine Mammal Responses to Pile Driving

The population consequences of disturbance has gained recent attention in marine mammals, and most models have focused on odontocetes (Booth et al. 2014; Farmer et al. 2018a; Farmer et al. 2018b; King et al. 2015; Natural England 2017; Pirotta et al. 2015; Roberts 2016) and pinnipeds (Costa 2012; 2013; Noren et al. 2009). Only recently have some bioenergetic models for mysticetes been developed (Pirotta et al. 2019; Van der Hoop et al. 2017; Villegas-Amtmann et al. 2015). Not all adverse responses to noise are expected to result in a reduction in individual fitness levels. In many cases, responses to noise can be localized and temporary, and individuals can be assumed to resume normal functioning when exposure to the stressor ceases.

A study on the first German offshore wind farm showed that fewer porpoises were detected up to 12 miles (20 kilometers) from the pile-driving site and that the displacement period (up to six days) was positively correlated to the duration of the pile driving (Dähne et al. 2013). In an analysis of eight offshore wind facility projects, Brandt et al. 2016 found a clear gradient in the decline of porpoise detections at different distances to pile driving. Gradient effects showed that at 0 to 3.1 miles (0 to 5 kilometers) porpoise detections declined by about 68 percent; at 6.2 to 9.3 miles (10 to 15 kilometers) detections declined by about 26 percent, with no clear reduction in porpoise detections beyond 10.6 to 12.4 miles (17 to 20 kilometers). Following pile driving, porpoise detections increased 12 hours after pile driving at 12.4 miles (20 kilometers), and increased 20 to 31 hours after pile driving at closer distances up to 1.2 miles (2 kilometers). Little to no habituation was found and there was no indication for the presence of temporal cumulative effects from construction of the eight wind facilities (Brandt et al. 2016). Scheidat et al. (2011) studied the effect on harbor porpoises over several years both before and after the installation of WTGs using acoustic data loggers placed on the seafloor both inside and outside the wind project. The study found a significant increase of 160 percent in the presence of porpoises 1 to 2 years after the wind facility was in normal operation compared to the baseline period (the construction period was not studied). This effect was linked to likely increases in food availability as well as the exclusion of fisheries and reduced vessel traffic in the wind project (Scheidat et al. 2013, Lindeboom et al. 2011).

Harbor seals have also been shown to have their behavior affected by pile-driving noise. A harbor seal telemetry study off the east coast of England found that seal abundance was reduced by 19 to 83 percent up to 15.5 miles (25 kilometers) during pile driving of WTG monopile foundations, but found no significant displacement resulted from construction overall as the seals' distribution was consistent with the non-piling scenario within 2 hours of cessation of pile driving (Russell et al. 2016) and they may increasingly use the foundations for foraging opportunities following installation of the subsea structures (Russell et al. 2016). Based on 2 years of monitoring at the Egmond aan Zee offshore wind project in the Dutch North Sea, satellite telemetry, while inconclusive, seemed to show that harbor seals avoided an area up to 24.8 miles (40 kilometers) from the construction site during pile driving, though the seals were documented inside the wind farm after construction ended, indicating any avoidance was temporary (Lindeboom et al. 2011). These findings are consistent with the best available information on noise and marine mammals which predicts a spectrum of effects depending on duration and intensity of exposure as well as species and behavior of the animal (e.g., migrating, foraging), ranging from injury to minor behavioral disturbance.

Taken as a whole, the available literature suggests avoidance of pile driving at offshore wind projects has occurred in some instances, with the duration of avoidance varying greatly, indicating that marine mammal responses to pile driving in the offshore environment are unpredictable and are likely context-dependent. However, pile driving will occur in open ocean areas where marine mammals may freely move away from the sound source; therefore, BOEM does not anticipate situations where individual marine mammals would not be able to escape from disturbing levels of noise. Further, as noted above, minimization and mitigation measures will be implemented which will reduce the severity of effects to individuals which reduces the potential for impacts on populations.

For the projects considered under the cumulative scenario, the potential for any behavioral disturbance to be significant to the individual depends on several factors including the location of the pile(s) being driven, the behaviors being carried out by individuals (e.g., migrating, foraging) and the distribution of habitats that support those behaviors. For example, an animal that has its foraging activity disrupted by pile-driving noise would be expected to swim away from the noise source until it is far enough away that the noise is no longer at disturbing levels. If prey resources are adequate and available in the area that the animal is displaced to, the impact of that displacement may be limited just to the energy resources used for avoidance and any energetic costs of lost foraging opportunities while an animal that is displaced to an area with forage that is absent or less abundant or available may experience a greater energetic cost. In general, the more frequently an animal has its normal behaviors disrupted and the longer the duration those disruptions are, the greater the potential for biologically significant consequences.

As noted above, BOEM assumes that future COP approvals will include project-specific mitigation and monitoring measures developed through NEPA, ESA consultations, and ITAs that will be implemented by each future project that will be designed to avoid exposure of individuals to injurious levels of noise and minimize and monitor effects of exposure that would result in behavioral responses. This may reduce the cumulative impacts on any individual by reducing project-specific impacts. As noted above, the available literature suggests that individual marine mammals will avoid disturbing levels of noise by swimming away from the noise source, with the duration of avoidance varying greatly, indicating that marine mammal responses to pile driving in the offshore environment are unpredictable and are likely context-dependent. The potential for biologically significant responses is expected to increase with increased exposure to multiple pile driving events.

Noise associated with cable laying would be produced during route identification, trenching, jet plow embedment, and backfilling, and cable protection installation by vessels and equipment, with intensity and propagation dependent upon bathymetry, local seafloor characteristics, vessels and equipment used (Taormina et al. 2018). Modeling using *in situ* data collected during cable laying operations in Europe estimate that underwater noise would remain above 120 decibels relative to one micropascal (dB re 1 micropascal) in an area of 98,842 acres (400 km^2) around the source (Bald et al. 2015; Nedwell and Howell 2004, Taormina et al. 2018). If cable-laying activities are assumed to occur 24 hours per day, the dynamic positioning (DP) vessel would continually move along the cable route over a 24-hour period, and the area within the 120 dB root mean squared (RMS) isopleth would also be constantly moving over the same period. Thus, the estimated ensonified areas would not remain in the same location for more than a few hours (NMFS 2015) and it is unlikely that the sound exposure related to cable-laying activities would result in adverse effects on marine mammals.

Noise associated with operational WTGs, while audible to marine mammals, would not be expected to result in measurable impacts on individuals as the SPLs generated by WTGs would be expected to be at or below ambient levels at a relatively short distance from WTG foundations (Kraus et al. 2016a, Thomsen et al. 2015). According to measurements at the Block Island Wind Farm, low frequency noise generated by turbines reaches ambient levels at 164 feet (50 meters; Miller and Potty 2017). SPL measurements from operational WTGs in Europe indicate a range of 109 to 127 dB re 1 μPa at 46 and 65.6 feet (14 and 20 meters) from the WTGs (Tougaard and Henrikson 2009). Although SPLs may be different in the local conditions of a project area, if sound levels at the project area are similar, operational noise could be slightly higher than ambient, which ranged from 96 to greater than 103 dB re 11μPa in the 70.8 to 224 hertz (Hz) frequency band at the study area during 50 percent of the recording time between November 2011 and March 2015 (Kraus et al. 2016a). As such, little to no impacts on individual marine mammals would be expected to occur.

The frequency range for vessel noise falls within marine mammals' known range of hearing and would be audible. While vessel noise may have some effect on marine mammal behavior, it would be expected to be limited to temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes (Erbe et al. 2018; Erbe et al. 2019; Nowacek et al. 2007). Studies indicate noise from shipping increases stress hormone levels in NARWs (Rolland et al. 2012), and modeling suggests that their communication space has been reduced substantially by anthropogenic noise (Hatch et al. 2012). The authors also suggest that physiological stress may contribute to suppressed immunity and reduced reproductive rates and fecundity in NARWs (Hatch et al. 2012; Rolland et al. 2012). Similar impacts could occur for other marine mammal species. Other behavioral responses to vessel noise could include animals avoiding the ensonified area, which may have been used as a forage, migratory, or socializing area. Results from studies on acoustic impacts from vessel noise on odontocetes indicate that small vessels at a speed of 5 knots in shallow coastal water can reduce the communication range for bottlenose dolphins within 164 feet (50 meters) of the vessel by 26 percent (Jensen et al. 2009). Pilot whales in a quieter, deep-water habitat could experience a 50 percent reduction in communication range from a similar size boat and speed (Jensen et al. 2009). Since lower frequencies propagate farther away from the sound source compared to higher frequencies, low frequency cetaceans are at a greater risk of exposure to noise from vessel traffic due to the frequencies associated with vessel traffic. Based on the vessel traffic generated by the proposed Project, it is assumed that construction of each individual offshore wind project (estimated to last 2 years per project) would generate an average of 25 and a maximum of 46 vessels operating in the geographic analysis area for marine mammals at any given time, although actual vessel trips would vary by project based on individual project designs and port locations. This increase in vessel traffic and associated noise impacts would be at its peak in 2022 to 2023, when at least five offshore wind projects (not including the Proposed Action) would be under simultaneous construction along the east coast—i.e., a total of approximately 125 to 230 vessels in the geographic analysis area at any given time during peak construction.[4] Additional information regarding the expected increase in vessel traffic is provided in Section 3.13. This increased offshore wind-related vessel traffic during construction, and associated noise impacts, could result in repeated localized, intermittent, short-term, impacts on marine mammals and result in brief behavioral responses that would be expected to dissipate once the vessel or the individual has left the area. However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of marine mammals, and no stock or population-level effects would be expected. Noise associated with vessel traffic would peak during a projects construction phase, but BOEM does not expect PTS-causing SPLs to result from vessel noise, though the intermittent, temporary impacts may result in brief behavior responses. Should multiple project construction activities occur in close spatial and temporal proximity, stock-level impacts are possible absent the implementation of avoidance, minimization, and mitigation measures intended to reduce these impacts on marine mammals.

Port expansion/utilization: Increases in global shipping traffic and expected increases in port activity along the East Coast from Maine to Virginia will require port modifications to receive the increase in shipping traffic and increased ship size. However, future offshore wind development is expected to be a minor component of port expansion activities required to meet increased commercial, industrial, and recreational demand. The current bearing capacity of existing ports is considered suitable for wind turbines, requiring no port modifications for supporting offshore wind energy development (DOE 2014). Future channel deepening that may be necessary to accommodate larger ships required to carry offshore WTG components and/or increased vessel traffic associated with offshore wind projects may result in increased potential high intensity impacts including noise impacts, vessel strikes, and impacts on prey species, but exposure and risk would be expected to be localized to near shore habitats. There are at least two proposed offshore wind projects that are contemplating port expansion/modification in Vineyard Haven and in Montauk. It is likely that other ports would be upgraded along the east coast, and some of this may be attributable to supporting the offshore wind industry. These port expansions would increase the total amount of disturbed benthic habitat, potentially resulting in impacts on marine mammal prey species. However, the expected disturbance of benthic habitat and the resulting impacts on marine mammals will likely be a small percentage of available benthic habitat overall. Increases in port utilization due to other offshore wind energy projects will lead to increases in vessel traffic. This increase will be at its peak during construction activities and will decrease during operations, but will increase again during decommissioning. In addition, any related port expansion and construction activities related to the additional offshore wind projects would add to increased turbidity in the coastal waters.

Presence of structures: The presence of structures can lead to impacts, both beneficial and adverse, on marine mammals through localized changes to hydrodynamic disturbance, prey aggregation and associated increase in foraging opportunities, entanglement and gear loss/damage, migration disturbances, and displacement. These impacts may arise from buoys, met towers, foundations, scour/cable protections, and transmission cable infrastructure during any stage of a project. Using the assumptions in Table A-4 in Appendix A, the expanded cumulative scenario would include up to 2,066 foundations, 2,944 acres (12 km^2) of new scour protection and hard protection atop cables. Projects may also install more buoys and met towers. BOEM anticipates that structures would be added intermittently over an assumed 6- to 10-year period beginning in 2022 and that they would remain until decommissioning of each facility is complete (30 years).

Manmade structures, especially tall vertical structures such as WTG and ESP foundations, alter local water flow at a fine scale, and could potentially result in localized impacts on marine mammal prey distribution and abundance (Section 3.4.1.1). Water flow typically returns to background levels within a relatively short distance from the structure. Tank tests, such as the one conducted by Miles et al. (2017), conclude that mean flows are reduced immediately downstream of a monopile foundation, but return to background levels within a distance proportional to the pile diameter (D). For foundations like those proposed by Vineyard Wind, background conditions would return approximately 328 feet (100 meters) away from each monopile foundation. Hydrodynamic disturbance can increase seabed scour and sediment suspension around foundations, but BMPs would be in place to minimize scour; therefore, sediment plumes, if any, would return to baseline conditions within a short distance.

The changes in fluid flow caused by the presence of an estimated 2,066 structures could also influence marine mammals prey species at a broader spatial scale. The existing physical oceanographic conditions in the geographic analysis area, with a particular focus on the Southern New England region, are described in Appendix B of the Draft EIS. Although waters on the OCS experience considerable vertical mixing throughout much of the year, an important seasonal feature influencing marine mammal prey is the cold pool, a mass of cold bottom water in the mid-Atlantic bight overlain and surrounded by warmer water. The cold pool forms in late spring and persists through summer, gradually moving southwest, shrinking, and warming due to vertical mixing and other factors (Chen et al. 2018). During summer, local upwelling and local mixing of the cold pool with surface waters provides a source of nutrients, influencing primary productivity of the ecosystem, which in turn influences finfish and invertebrates (Lentz 2017, Matte and

[4] As specified in Section 1.2 of this SEIS, BOEM's analysis of the reasonably foreseeable build-out scenario assumes that the potential challenges of vessel availability and supply chain will be overcome and projects will advance as specified in the scenario.

Waldhauer 1984). The presence of many wind turbine structures could affect oceanographic and atmospheric conditions by reducing wind-forced mixing of surface waters and increasing vertical mixing of water forced by currents flowing around foundations (Carpenter et al. 2016; Schultze et al. 2020). During times of stratification (summer), increased mixing could possibly increase pelagic primary productivity in local areas. However, changes in primary productivity might not translate into effects on marine mammal prey species if the increased productivity is consumed by filter feeders, such as mussels, that colonize the surface of the structures (Slavik et al. 2019). The ultimate effects on marine mammal prey species, and therefore marine mammals, of changes to oceanographic and atmospheric conditions caused by the presence of offshore structures are not known at this time, and they are likely to vary seasonally and regionally.

The presence of new structures could result in increased prey items for some marine mammal species. WTG and ESP foundations could increase the mixing of surface waters and deepen the thermocline, possibly increasing pelagic productivity in local areas (English et al. 2017). Additionally, hard-bottom (scour control and rock mattresses used to bury required offshore export cables) and vertical structures (i.e., WTG and ESP 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). Invertebrate and fish assemblages may develop around these reef-like elements within the first year or two after construction (English et al. 2017). Although some studies have noted increased biomass and increased production of particulate organic matter by epifauna growing on submerged foundations, it is not clear to what extent the reef effect results in increased productivity versus simply attracting and aggregating fish from the surrounding areas (Causon and Gill 2018). Recent studies have found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, marine mammals, and birds as well (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019), indicating that offshore wind farms can generate beneficial permanent impacts on local ecosystems, translating to increased foraging opportunities for marine mammal species (Section 3.4.1.1). Current data that suggest seals (Russell et al. 2016) and harbor porpoises (Scheidat et al. 2011) may be attracted to the future offshore wind development infrastructure. Since seals and harbor porpoise occur in the geographic analysis area, it is likely that these species would be attracted to the forage items including shellfish and other fish species and shelter provided within individual project areas. As such, some marine mammals, i.e. seals and small odontocetes, would be expected to use habitat in between the WTGs as well as around structures for feeding, resting, and migrating. The vertical WTG structures may also result in increased primary production and zooplankton abundance, increasing prey availability for mysticete whales, relative to surrounding locations.

While the anticipated reef effect would be expected to result in beneficial effects to several groups of marine mammals, some potential for increased exposure to high intensity risk of interactions with fishing gear that may lead to entanglement, ingestion, injury, and death exists. The presence of structures may indirectly concentrate recreational fishing around foundations, both personal and for-hire, and would also increase the risk of gear loss/damage by entanglement, potentially indirectly increasing the potential for entanglement in both lines and nets and leading to injury and mortality due to infection, starvation, or drowning (Moore and van de Hoop 2012). Additionally, commercial and recreational fishing vessels may be displaced outside of the WDAs. The cumulative scenario would impact all fisheries and all gear types (NOAA 2019e). Bottom tending mobile gear is more likely to be displaced than fixed gear. The 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. Fisheries interactions, including various gillnet and trawl fisheries in New England and the Mid-Atlantic Coast are likely to have demographic effects on marine mammal species. Entanglement in fishing gear has been identified as one of the leading causes of mortality in NARW, and may be a limiting factor in the species recovery (Knowlton et al. 2012). Johnson et al. (2005) report that 72 percent of NARWs show evidence of past entanglements. Entanglement may also be responsible for high mortality rates in other large whale species (Read et al. 2006). Abandoned or lost fishing gear may get tangled with foundations, reducing the chance that abandoned gear will cause additional harm to marine mammals and other wildlife, though debris tangled with WTG foundations may still pose a hazard to marine mammals. These potential long-term intermittent impacts would persist until decommissioning is complete and structures are removed. The presence of structures and the anticipated reef effect has the potential to lead to increased recreational fishing within the lease areas and result in moderate exposure, high intensity risk of interactions with fishing gear that may lead to entanglement, ingestion, injury, and death (Moore and van der Hoop 2012). Although the reef effect may result in drawing in recreational fishing effort from inshore areas, an overall interaction between marine mammals and fisheries resulting from increased effort offshore would not change the overlap in recreational fishing effort and marine mammal distributions. Fishing in and around foundations may increase marine debris from fouled fishing gear in the area. However, entanglement and ingestion of marine debris, is not considered a new impact-producing factor but rather a change in the distribution of this factor if inshore fishing effort is moved offshore, with the potential for different species to be affected. Some level of displacement of marine mammals out of the lease areas into areas with a higher potential for interactions with ships or fishing gear during the construction phases of future offshore wind development may occur (Section 3.12). Additionally, some marine mammals may avoid the lease areas during all phases (construction, operations, and decommissioning) of the future offshore wind development. The presence of vertical WTG structures may interfere with echolocation behaviors exhibited by odontocetes whales as demonstrated at an offshore wind facility in Denmark (Teilmann and Carstensen 2012). While the proposed 1 nautical mile spacing between WTGs would be sufficient to allow unimpeded movement within and between offshore wind facilities, there is a lack of information and a large amount of uncertainty relative to large whale responses to the presence of offshore WTG structures. Long-term, intermittent impacts on foraging, migratory movements, or other important behaviors may occur as a result of the future offshore wind development. Additionally, temporary displacement from the WDAs during construction of projects into areas with higher risk of interactions with fishing and commercial vessels (see increased vessel traffic below) may also contribute to impacts on marine mammals.

Increased vessel traffic: Vessel traffic associated with future offshore wind development poses a high frequency, high exposure, collision risk to marine mammals, especially NARWs, other baleen whales, and calves that spend considerably more time at/near the ocean surface. Vessel strike is relatively common with cetaceans (Kraus et al. 2005) and one of the primary causes of death to NARWs with as many as 75 percent of known anthropogenic mortalities of NARWs likely resulting from collisions with large ships along the US and Canadian eastern seaboard (Kite-Powell et al. 2007). Marine mammals are more vulnerable to vessel strike when they are within the draft of the vessel and when they are beneath the surface and not detectable by visual observers. Some conditions that make marine mammals less detectable include weather conditions with poor visibility (e.g., fog, rain, and wave height) or nighttime operations. Vessels operating at speeds exceeding 10 knots have been associated with the highest risk for vessel strikes of NARWs (Vanderlaan and Taggart 2007). Reported vessel collisions with whales show that serious injury rarely occurs at speeds below 10 knots (Laist et al. 2001). Data show that the probability of a vessel strike increases with the velocity of a vessel (Pace and Silber 2005; Vanderlaan and Taggart 2007). Offshore wind development will result in only a small incremental increase in vessel traffic volume relative to ongoing and future non-offshore activities, and no measurable cumulative impacts would be expected as result. Some level of cumulative effects can be expected should multiple projects be in the construction phase simultaneously. As described under the Noise section, at the peak of project construction from 2022 to 2023 up to 230 vessels associated with offshore wind development along the east coast may be operating in the geographic analysis area. However, this vessel traffic increase would be expected to result in only a small incremental increase in overall vessel traffic within the geographic analysis area for marine mammals. Further, collision risk would only be expected when Project vessels are transiting to and from the WDAs. Once in the WDAs, vessels would be stationary during construction activities and no collision risk would be expected. Additionally, vessels transiting from WTG foundation locations would do so at lower speeds than when transiting from ports to the WDA. While BMPs and mitigation measures required by BOEM and NMFS may avoid or reduce the likelihood of fatal vessel interactions, increased potential interactions would be expected in lease areas, with greatest impact potential occurring during construction activities when vessel traffic volumes would be the greatest, though some increased risk would also be expected during operations and decommissioning as well. This increased collision risk has the potential to result in injury or mortality to individuals. The relative risk of vessel strikes from wind industry vessels is dependent upon the stage of development, time of year, number of vessels, and speed of vessels during each stage.

Temporary and/or permanent increases in vessel traffic outside of lease areas may also occur due to displacement of commercial and recreational fishing vessels. Bottom tending mobile gear is more likely to be displaced form the WDAs than fixed gear. The expanded cumulative impact scenario 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. More information regarding the potential for displacement of fishing vessels is provided in Section 3.11. Displacement of these vessels and gear types may lead to increased interactions with marine mammals that are also temporarily or permanently displaced out of the lease areas.

Climate change: Several IPFs related to climate change, including increased storm severity and frequency, increased erosion and sediment deposition, increased disease frequency, ocean acidification, as well as altered habitat, ecology, and migration patterns, have the potential to result in impacts on marine mammals. These long-term, high consequence impacts could include increased energetic costs associated with altered migration routes, reduction of suitable breeding and/or foraging habitat, and reduced individual fitness, particularly juveniles. However, future offshore wind development would not be expected to contribute to climate change impacts on marine mammals. Section A.8.1 details the expected contribution of offshore wind activities to climate change.

3.5.1.2. Conclusions

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impacts on marine mammals. BOEM expects ongoing activities, future non-offshore wind, and future offshore wind activities to have continuing temporary to permanent impacts on marine mammals, primarily through pile driving noise, vessel noise, presence of structures, vessel traffic, commercial and recreational fisheries gear interactions, and climate.

Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in moderate adverse impacts because of the presence of structures and pile-driving noise. Additionally, the presence of structures could result in moderate beneficial impacts on marine mammals. The majority of offshore structures in the geographic analysis area for marine mammals would be attributable to the offshore wind industry. The offshore wind industry would also be responsible for a majority of the impacts associated with new cable emplacement and EMF, but effects to marine mammals resulting from these IPFs would be localized and temporary, and would not be expected to be biologically significant.

Under the No Action Alternative, there would be no impact on marine mammals from the Proposed Action (described in the Draft EIS Section 3.3.7.3), which would not be built. The resource would continue to follow current regional trends and respond to current and future environmental and societal activities, including the future offshore wind activities assumed in BOEM's scenario. Detailed information regarding the status of marine mammals in the geographic analysis area is provided in BOEM's Draft EIS and the BA submitted to NOAA (BOEM 2019a). The No Action Alternative would forgo the long-term PAM, vessel strike reporting, and pile-driving monitoring, that Vineyard Wind has committed to voluntarily perform, the results of which could provide an understanding of the effects of offshore wind development, benefit future management of these resources, and inform planning of other offshore developments. BOEM acknowledges, however, that other ongoing and future surveys could provide similar data to support similar goals.

3.5.2. Proposed Action and Action Alternatives

3.5.2.1. Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on marine mammals were described in the Draft EIS Section 3.3.7.3, and additional information is included in Table 3.5-1. The Proposed Action would likely result in temporary to permanent impacts that are generally localized and range from negligible to moderate, and may include minor beneficial impacts. The Proposed Action would contribute to impacts through all of the IPFs named in Section 3.5.1.1 except port expansion; the Proposed Action would not directly involve port upgrades. 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 would likely include pile-driving noise, which could cause noticeable temporary impacts for 4 to 6 hours at a time during construction, increased vessel traffic and the presence of structures, which would lead to permanent impacts. Other IPFs would likely contribute impacts of lesser intensity and extent, and would occur primarily during construction, but also during operations and decommissioning (Table 3.5-1). A total of four IPFs or sub-IPFs in Table 3.5-1 were not previously discussed in the Draft EIS sections regarding marine mammals, including accidental releases, G&G survey noise, long-term avoidance/displacement from the WDA during breeding and/or migration, and climate change.

The Draft EIS identified accidental releases as an ongoing threat to marine mammals, but did not contemplate the potential for impacts on individual marine mammals as a result of the Proposed Action. Generally, accidental releases of hazardous materials, trash, and debris are expected to be rare, highly localized, and temporary. The proposed Project could lead to an increased potential for a release that may result in rare, localized, and temporary **negligible** impacts, including individual mortality, decreased individual fitness, and health effects. However, all vessels associated with the Proposed Action will comply with the USCG requirements for the prevention and control of oil and fuel spills minimizing effects to marine mammals resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012a). Trash and debris may also be released by proposed Project vessels during construction, operations, and decommissioning. BOEM assumes operator compliance with federal and international requirements for management of shipboard trash; such events also have a relatively limited spatial impact. While precautions to prevent accidental releases will be employed by vessels and port operations associated with the Vineyard Wind 1 Project, it is likely that some debris could be lost overboard during construction, maintenance, and routine vessel activities. However, the amount would likely be miniscule compared to other inputs. In the event of a release, it would be an accidental, localized event in the vicinity of project areas, likely resulting non-measurable **negligible** impacts, if any. Further, BMPs proposed for waste management and mitigation for marine debris training and awareness of proposed Project personnel would be required, reducing the likelihood of occurrence to a very low risk.

The Draft EIS also did not consider noise from G&G surveys because it was previously assumed that the Proposed Action would not lead to impacts related to site assessment G&G surveys as these surveys have been completed for the Proposed Action; however, this SEIS now considers G&G surveys associated with operations, maintenance, and decommissioning activities. G&G surveys may be associated with the inspection of project cables and foundations after installation; site clearance activities associated with decommissioning may result in impacts on marine mammals as a result of noise associated with these surveys. Noise from G&G surveys during inspection and/or monitoring of cables may occur during the proposed Project. G&G survey effort resulting from these post-construction surveys may be shorter in duration and of smaller in scope than site investigation surveys in WDAs. Given that all G&G survey would be conducted in accordance with an approved Incidental Harassment Authorization (IHA), **negligible** impacts on marine mammals, if any, are anticipated to be localized and temporary.

The Draft EIS provided a discussion of temporary avoidance/displacement of marine mammals during the course of the proposed Project construction, specifically, during pile-driving activities. Table 3.5-1 now considers the potential for long-term displacement due to the presence of structures on the OCS. A large amount of uncertainty exists regarding the potential impacts of offshore wind development on large whale behavior and movement patterns. Unanticipated effects resulting from impacts on foraging or other important behaviors could occur and may include additional energy expenditure and associated physiological effects if individual WTGs or the entire WDA is avoided. Given marine mammal mobility and their capacity for long-distance migration, these impacts, if any, would be expected to **negligible**.

Finally, while the Draft EIS states that some mammal species may be susceptible to impacts arising from climate change, no discussion of what those impacts could be was provided. Several sub-IPFs discussed in Table 3.5-1, including increased storm severity and frequency, ocean acidification, altered migration patterns, increased disease frequency, protective measures such as seawalls or other barriers, and increased erosion and sediment deposition, have the potential to result in long-term, possibly high-consequence risks to marine mammals and could lead to reduced productivity; reduced fitness or mortality of juveniles and adults; changes in prey abundance, availability, and distribution; changes in breeding and foraging habitat abundance, availability, and distribution; increased disease prevalence and infections; and changes to migration patterns and timing.

Changes to the design capacity of the WTGs to be used would not alter the maximum potential impacts on marine mammals for the Proposed Action and all other action alternatives because the maximum-case scenario involved the maximum number of WTGs (100) specified in the PDE. Changes to the design of the onshore substation would also not alter the potential impacts on marine mammals for the Proposed Action and all other action alternatives because the substation site is inland where marine mammals would not reside.

The cumulative impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are listed by IPF in Table 3.5-1. The nature of the primary IPFs and of potential impacts on marine mammals is described in detail in Section 3.5.1.1. Under the No Action Alternative, BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities other than the proposed Project to have continuing temporary to permanent impacts on marine mammals across the range of IPFs, primarily through the following IPFs: G&G survey noise, pile-driving noise, presence of structures, vessel traffic, and climate change.

The cumulative impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities would be of the similar types described in Section 3.5.1, but may differ in intensity and extent. It is assumed that the energy demand that the Vineyard Wind 1 Project would fill (if approved), would likely be met by other projects in remaining areas of the Massachusetts, Rhode Island, and/or New York leases (if not approved). Although the impacts from a substitute project may differ in location and time, depending on where and when offshore wind facilities are built out to meet the remaining demand, the nature of impacts and the total number of WTGs would be similar either with or without the Proposed Action, as described in Section 3.5.1. In other words, future offshore wind facilities capable of generating 9,404 MW would be built in RI and MA Lease Areas, although, in the absence of the Proposed Action, none would be built before 2022. Therefore, the cumulative impacts related to WTGs would generally be equal to those described in Section 3.5.1.2. The remainder of this subsection focuses on potential incremental impacts of the Proposed Action that would differ in intensity and/or extent from the No Action Alternative impacts described in Section 3.5.1.

Accidental releases: The incremental impacts of the Proposed Action from accidental releases of hazardous materials and trash/debris would not increase the risk beyond that described under the No Action Alternative. Further, the Proposed Action would comply with the USCG 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 Vineyard Wind 1 Project personnel, reducing the likelihood of an accidental release. As such, BOEM anticipates that the Proposed Action would contribute negligible cumulative impacts, if any, due to the rare, brief, and highly localized nature of accidental releases. Future offshore wind activities would contribute to an increased risk of spills and associated impacts due to fuel, fluid, hazmat, trash, or debris exposure. The contribution from future offshore wind and the Proposed Action would be a low percentage of the overall spill risk from ongoing activities. The cumulative impacts on marine mammals from accidental releases associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be highly localized and temporary due to the likely limited extent and duration of a release, resulting in negligible impacts.

EMF: While EMF associated with the proposed Project's submerged cables would be detectable by marine mammals, non-measurable-negligible impacts, if any, would be expected due to the localized nature of EMF along the cables near the sea floor, the wide ranges of marine mammals, and appropriate shielding and burial depth. EMF from multiple cables would not overlap even for multiple cables within a single OECC. The cumulative impacts on marine mammals from EMF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be highly localized and long-term, resulting in negligible cumulative impacts.

New cable emplacement and maintenance activities: The Proposed Action's incremental contribution of up to 328 acres (1.3 km^2) of seafloor disturbance by cable installation and up to 69 acres (0.3 km^2) affected by dredging prior to cable installation would result in turbidity effects that have the potential to have temporary impacts on some marine mammal prey species (Sections 3.3.2 and 3.4.2). Based on the assumptions in Table A-6 in Appendix A, only the South Fork Wind Project (OCS-A 0486) cable laying would overlap in time with the Proposed Action cable laying (2021-2022). However, given the localized nature of these impacts, impacts associated with the emplacement of South Fork Wind's export and inter-array cabling would not overlap spatially with the Proposed Action and no cumulative impacts would be expected. 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 also 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. Some non-measurable negligible cumulative impacts arising from the Proposed Action when combined with past, present, and reasonably foreseeable activities could occur if impacts occur in close temporal and spatial proximity, though these impacts would not be expected to be biologically significant.

Noise: The various types of negligible to moderate impacts on marine mammals due to anthropogenic noise associated with the incremental impacts of the Proposed Action would not increase the impacts of noise beyond the impacts described under the No Action Alternative. BOEM expects that helicopters transiting to the Vineyard Wind 1 Project area would fly at altitudes above those that would cause behavioral responses from marine mammals except when flying low to inspect WTGs or to take off and land on the SOV. While helicopter traffic may cause some short-term behavioral reactions in marine mammals, BOEM expects these impacts to be short-term, temporary, and negligible, resulting in minimal energy expenditure.

Marine mammals would be able to hear the continuous underwater noise of operational WTGs. However, based on the results from Thomsen et al. (2015) and Kraus et al. (2016a), the received SPLs generated by the Project turbines are expected to be at or below ambient levels at relatively short distances (164 feet [50 meters]) from the foundations (Miller and Potty 2017). Given that WTG noise would be at or below ambient within a short distance from WTG bases, non-measurable negligible impacts, if any would be expected to occur.

There is a potential risk of PTS and harassment to marine mammals from pile driving due to the large radial distance to this threshold and maximum-case scenario over the total of 102 days that pile driving may occur. Vineyard Wind has committed to voluntarily implement measures of utilizing soft start, PSOs, and PAM would reduce the potential impacts on marine mammals.[5] Additionally, the peak season of NARW occurrence between January and April would be completed avoided and no pile driving would occur at that time. Additional detail on the voluntarily measures Vineyard Wind has committed to are described in detail in Pyć et al. 2018, Appendix D of the Draft EIS, and in the BA submitted to NOAA (BOEM 2019a). Overall, the modeled predicted exposure rates indicate that impacts would be expected to be negligible for mid- and high-frequency cetaceans and pinnipeds for both potential injury and behavior disruption based upon the number of individuals effected relative the size of the overall populations. In this group, only the sperm whale is endangered, but would not be expected to be exposed to pile driving noise due to low densities and preference for deep water (Pýc et al. 2018). For low-frequency cetaceans, under the maximum case scenario, the modeled predicted risk of injury was a very low percentage of species abundance, without sound attenuation or aversion used in the modeled scenarios (Pýc 2018). Based on the analysis, BOEM considers impacts from pile driving to be minor for NARW due to avoidance of peak seasons of occurrence and moderate for all other marine mammals. Pile-driving activities would be conducted in accordance with a project-specific IHA that would require the use of PSOs, PAM, monitoring zones, and other mitigation and monitoring measures to minimize impacts on marine mammals. Based on the current anticipated construction schedule in Table A-6 in Appendix A, the only future offshore wind project that may conduct pile-driving activities within the same year and region as the Vineyard Wind 1 Project construction is the South Fork Wind Project. The South Fork Wind Project proposes to install up to 16 foundations, of which all may be secured to the seafloor by piles. Only one foundation per day is proposed by South Fork resulting in a maximum of 16 days of

[5] While Vineyard Wind has committed to voluntarily implement some mitigation and monitoring measures, some of those measures as well as others would be required by NMFS in the IHA issued for the proposed Project.

potential concurrent pile driving with the Vineyard Wind 1 Project. Adding the distances from the modeling results completed by Vineyard (a 33.8-foot [10.3-meter)] pile with 0 dB attenuation) for harassment of low frequency cetaceans (approximately 3.9 miles [6.32 kilometers]) and the South Fork modeling (an 11-meter pile with 0 dB attenuation during summer) of approximately 10.15 kilometers, an area with a diameter of approximately 36.1 feet (33 kilometers) could have increased underwater noise that would be expected to result in behavioral disturbance to marine mammals. Pile driving could be expected to occur between 2 to 6 hours per day (two foundations per day) for Vineyard Wind 1 Project and 1 to 3 hours per day for South Fork, resulting in up to 9 hours per day. Considering the slowest swimming speed of 0.7 mile (1.1 kilometers) per hour for a mom and calf pair (Hain et al. 2013), a whale would need to spend 30 hours traveling and not feeding, to get outside the 20.5-mile (33-kilometer) area with disturbing levels of noise. However, pile driving may only occur for a maximum of 9 hours per day for a cumulative scenario of three piles per day for both projects. Assuming that time exposed to pile-driving noise and/or spent avoiding pile-driving noise equates to lost foraging potential, under the cumulative pile-driving scenario for the Vineyard Wind 1 and South Fork projects, NARW may lose up to a maximum of 37.5 percent of their daily time spent foraging due to avoidance of up to three piles per day installed between the neighboring projects. Actual lost foraging potential is dependent on the distribution of forage in a particular area, the duration of the disturbance, and ability to resume foraging in the area where an animal was displaced to.

According to the Navigation Risk Assessment (COP Appendix III-I; Epsilon 2018a), current vessel traffic in the Project area and surrounding waters is relatively high, and vessel traffic within the Vineyard Wind lease area is relatively moderate (Draft EIS Section 3.4.7). The NRA for the Project area indicates that the maximum number of vessels during construction would be 46 per day (with an average of 25 per day) (COP Appendix III-I; Epsilon 2018a). This volume of traffic would vary monthly depending on weather and Proposed Action activities. Over the course of the entire construction phase, the Proposed Action would generate an average of seven daily vessel trips between both the primary and secondary ports and the Project area. During the period of maximum activity, Proposed Action construction would generate an average of 18 construction vessel trips per day in or out of construction ports. In maximum conditions, this could theoretically include up to 46 trips in a single day—including up to 4 trips per day to or from secondary ports, with the remainder originating or terminating at the New Bedford Marine Commerce Terminal (MCT), compared to the current 25 daily vessel trips measured via Automatic Identification System (AIS) in 2011 (COP Appendix III-I; Epsilon 2018a). Potential behavioral impacts on marine mammals from Proposed Action-related vessel traffic noise would be intermittent and temporary as animals and vessels pass near each other. During construction, impacts are anticipated to be moderate for all mysticetes because the lower frequency of sound emitted from vessels overlaps in the most sensitive hearing range of mysticetes and may affect mysticetes over larger areas compared to the other marine mammals. However, these impacts would be temporary, limited to construction months within the Project area, and are not expected to have stock or population-level effects. Potential temporary behavioral impacts on all other marine mammals are expected to be minor, with marine mammal populations fully recovering following construction of the proposed Project.

Cable laying noise associated with the Proposed Action may also affect marine mammals. The timeframe for offshore export cable installation is still being developed in response to time-of-year considerations, but it is likely that offshore export cable installation would occur in the period April through October. If offshore export cable installation occurs in April, it is possible that NARW would be feeding in the vicinity of the OECC. However, all appropriate mitigation measures would be implemented to minimize potential impacts, including the 1,640-foot (500-meter) setback (COP Addendum, Section 1.2.4; Epsilon 2019a). The cumulative sound exposure level over 24 hours (L_{E24}) during cable laying is expected to reach approximately 237 dB re 1 micropascal squared second (μPa^2s) at 1 meter (3.3 feet) (Xodus Group 2015), which exceeds the NMFS threshold criteria for PTS from non-impulsive noise (L_{E24} 199 dB re 1 μPa^2s; Pyć et al. 2018). The radial distance to the threshold criteria for Level A Harassment or Level B Harassment for marine mammals in the Proposed Action area is not known. The distance to the threshold for Level A Harassment is expected to be relatively small and the distance to threshold for Level B Harassment is expected to be in the range of other vessel noise. BOEM therefore anticipates minor temporary impacts from cable laying noise, with marine mammal populations fully recovering following cable installation. When all of the acoustic stressors described above and in Table 3.5-1 are cumulatively assessed, they are all likely to contribute in underwater sound levels that could cause behavioral harassment or injury to individual marine mammals in the geographic analysis area. Additionally, the intermittent exposure but persistent elevation in ambient noise across the geographic analysis area could produce physiological stress on individuals, to which the Proposed Action would contribute. Sounds from many of these sources travel over long distances, and it is possible that some would overlap in time and space with sounds from pile driving or other noise associated with the Proposed Action, in particular distant shipping noise, which is more widespread and continuous. It is not known whether the co-occurrence of shipping noise, geophysical surveys associated with renewable energy site characterization, military training, and sounds associated with pile driving would result in harmful additive impacts on marine mammals. However, these activities are widely dispersed, the sound sources are intermittent, and mitigation measures would be implemented to reduce acoustic disturbance from pile driving to reduce any potential cumulative exposure to elevated underwater sound levels of concern. The temporary to permanent cumulative noise impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be expected to range from and negligible to moderate. The temporary moderate impacts that would be expected to result from the pile driving of offshore wind projects would be added to existing noise levels beginning in 2021 and continuing through 2030 along the east coast. The IPF will be removed from the environment once pile driving is completed for the offshore wind projects, and behavior of marine mammals is expected to return to normal. However, the effects of PTS may be permanent.

Port expansion: No port expansion activities are contemplated for the Proposed Action. As such, the Proposed Action would not be expected to contribute appreciably to cumulative impacts on marine mammals.

Presence of structures: The various types of impacts on marine mammals that could result from the presence of structures, such as entanglement and gear loss/damage, fish aggregation, oceanographic impacts, and habitat conversion, and avoidance/displacement, are described in detail in Section 3.5.1.1. Using the assumptions in Table A-4 in Appendix A, there could be up to approximately 2,944 acres (12 km^2) of new hard protection. Of this area, only 151 acres (0.6 km^2) would result from the proposed Project, and the remainder would result from other offshore wind projects in the geographic analysis area. Of the estimated

2,066 structures, 102 would result from the proposed Project. The structures and scour/cable protection, and the potential consequential impacts would remain at least until decommissioning of each facility is complete (30 years). Structures associated with the Vineyard Wind 1 Project would be expected to provide some level of reef effect and may result in long-term **minor beneficial** impacts on seal and small odontocete foraging and sheltering, though long-term, **minor** cumulative impacts could occur as a result of increased interaction with active or ghost fishing gear. However, as part of the Proposed Action, annual monitoring, reporting, and cleanup of fishing gear around the base of the WTGs would be conducted. This would remove any identified fishing gear and reduce the potential for impacts on marine mammals to **negligible** levels. While the abandoned fishing gear would be removed, the potential for entanglement associated with active commercial or recreational fishing gear would still exist. Currently there is a large amount uncertainty around large whale response to offshore wind facilities due to the novelty of this type of development in the Atlantic. Monitoring studies would be able to determine more precisely any changes in whale behavior. Based on the best available information, none is anticipated. However, long-term, intermittent **minor** cumulative impacts on foraging, migratory movements, or other important behaviors may occur as a result of the Proposed Action when combined with past, present, and reasonably foreseeable activities. Additionally, temporary displacement from the WDA during Project construction into areas with higher risk of interactions with fishing and commercial vessels (see increased vessel traffic below) may also adversely contribute to cumulative impacts on marine mammals.

Overall, the presence of structures associated with the Proposed Action would be expected to result in **negligible** to **minor** impacts on marine mammals, as well as potential **minor beneficial** impacts (Table 3.5-2). The temporary to permanent cumulative impacts resulting from the presence of structures on the OCS associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be expected to range from **negligible** to **moderate** impacts and may include **moderate beneficial** impacts.

Increased vessel traffic: During the proposed Project's most active construction period, Vineyard Wind estimates that a maximum of approximately 46 vessels could operate simultaneously within the WDA or OECC. In an extreme case, all 46 of these vessels could need to travel to or from New Bedford or a secondary port in the same day; however, Vineyard Wind estimates that activities during the proposed Project's most active period would typically generate 18 vessel trips per day to or from ports. The maximum number of vessels involved in the proposed Project at any one time is highly dependent on the Project's final schedule, the final design of the Project's components, and the logistics solution used to achieve compliance with the Jones Act (COP Section 7.8, Volume III, and Appendix III-I; Epsilon 2020a). Given that vessel strike is relatively common with cetaceans (Kraus et al. 2005), vessel traffic associated with the proposed Project has the potential to pose a high-frequency, high-exposure collision risk to marine mammals especially NARWs, other baleen whales, and calves that spend considerably more time at/near the ocean surface. However, the Proposed Action would be expected to result in only a small incremental increase in vessel traffic, with a peak during Project construction. The NRA (COP Appendix III-I; Epsilon 2018a) found that no significant disruption of normal traffic patterns is anticipated in the WDA associated with the proposed Project. Therefore, even if vessel traffic in the region increases, the Proposed Action is not expected to significantly increase the cumulative risk of vessel allisions or collisions. Additionally, some risk would be mitigated with the implementation of vessel speed limits and the maintenance of marine mammal avoidance buffers. Due to the low level of increase in vessel traffic and the size and operational speed of Proposed Action vessels, BOEM anticipates **negligible** impacts on marine mammal species, with affected populations fully recovering once operations cease. BOEM anticipates the Proposed Action's potential vessel traffic impacts when combined with past, present, and reasonably foreseeable activities could result in **minor** to **moderate** cumulative impacts on marine mammals, depending on the duration of exposure; however, BOEM does not expect the viability of marine mammal stocks or populations to be effected. The relative risk of vessel strikes from vessels associated with the Proposed Action is dependent upon the stage of development (i.e. construction, operations, or decommissioning), time of year, number of vessels, and speed of vessels during each stage.

Vessel strike is one of the primary causes of death to NARWs, with as many as 75 percent of known anthropogenic mortalities of NARWs likely resulting from collisions with large ships along the U.S. and Canadian eastern seaboard (Kite-Powell et al. 2007). The Proposed Action includes a series of measures that Vineyard Wind has committed to voluntarily implement to reduce the potential for vessel strikes of listed species, including the NARW.

- NARW sightings information would be checked daily.
- If a NARW or large whale were observed within 328 feet (100 meters), the transiting vessel would shift engine to neutral and would not re-engage engines until the NARW has moved out of the vessel path and beyond 328 feet (100 meters).
- A 1,640-foot (500-meter) for
- NARWs (Vineyard Wind 2018) and 328-foot (100-meter) setback for other listed whale species would be maintained between all transiting construction-related vessels and whales.
- Transiting vessels would maintain a separation distance of 164 feet (50 meters) from all other marine mammals and dolphins.
- If cow/calf pairs or large groups of delphinids were observed within 164 feet (50 meters) of a vessel in transit, the vessel would reduce speed to 10 knots. Normal transit speed would be resumed only after the delphinids have moved outside the 164-foot (50-meter) zone.
- AIS would be required on each project vessel.

A detailed vessel strike analysis for the Proposed Action is provided in the Vineyard Wind BA (BOEM 2019a). Given the implementation of the above measures, vessel strike of NARW are not anticipated. Given Vineyard Wind's commitment to voluntarily implement the above measures, impacts on listed marine mammal species, if any, resulting from vessel strikes would be expected to be **negligible.**

Temporary and/or permanent increases in vessel traffic outside of the WDAs may also occur due to displacement of commercial and recreational fishing vessels. Bottom tending mobile gear is more likely to be displaced form the WDAs than fixed gear. The cumulative impact scenario 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. More information regarding the potential for displacement of fishing vessels is provided in Section 3.11.2. BOEM anticipates the Proposed Action's potential vessel traffic impacts, when combined with past, present, and reasonably foreseeable activities, could result in minor cumulative effects on marine mammals, depending on the duration of exposure. However, BOEM does not expect the viability of marine mammal stocks to be affected.

Climate change: The surveying, construction, and decommissioning activities associated with the proposed Project would produce GHG emissions that can be assumed to contribute to climate change; however, these contributions would be small (i.e., 6,990 metric tons) compared with the aggregate global emissions and would be less than the emissions offset during the operation of the offshore wind facility. The impact of GHG emissions on marine mammals from the Project would not be detectable. Given that the Proposed Action would produce less GHG emissions than similarly sized fossil-fuel powered generating stations, the cumulative effects associated with the expected reduction in GHG emissions would be expected to result in long term, low intensity beneficial cumulative impacts on marine mammals.

Other considerations: For temporary impacts, including the effects of pile-driving noise and new cable emplacement, it is likely that a portion—possibly the majority—of such impacts from future activities would not overlap in time with the temporary impacts of the Proposed Action. However, some IPFs that can cause temporary impacts can also cause long-term to permanent impacts.

The cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be several times greater than the incremental impacts of the Proposed Action alone. However, the incremental impacts of the Proposed Action would not add to the impacts of the No Action Alternative because, under the cumulative scenario described in Section 1.2.1, the total capacity of offshore wind development in the geographic analysis area for marine mammals would be the same whether the Proposed Action goes forward or not. BOEM assumes for this cumulative analysis that the number of WTGs would be similar in either case, as would the length of offshore export cable, inter-array cable, and associated disturbances. Thus, the primary differences between the Proposed Action and the No Action Alternative are the locations and times (years) in which the impacts would occur.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from negligible to moderate, and may include moderate beneficial impacts. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in moderate impacts on marine mammals in the geographic analysis area. The main drivers for this impact rating are pile driving, vessel and construction noise, increased vessel traffic associated with the cumulative impact scenario, and ongoing climate change. The Proposed Action would contribute to the overall impact rating primarily through noise-related IPFs and increased vessel traffic. Thus, the overall cumulative impact on marine mammals would likely qualify as moderate because a notable and measurable impact is anticipated, but the resource would likely recover completely when IPF stressors are removed and/or remedial or mitigating actions are taken.

3.5.2.2. Cumulative Impacts of Alternatives B, C, D1, D2, and E

The direct and indirect impacts associated with Alternatives B, C, D1 D2 and E are described in the Draft EIS Section 3.3.7. BOEM does not expect selection of the landfall location under Alternative B to have any measurable effect on marine mammals compared to the Proposed Action. Similarly, Alternative C would not appreciably change the expected potential impacts because the number of turbines remains the same, and the southern portion of the Project area does not include areas with higher densities of marine mammals. BOEM anticipates that the potential direct and indirect impacts associated with Alternatives B and C would not be measurably different from those anticipated under the Proposed Action (Draft EIS Section 3.3.7.4). Under Alternative D1, the total acreage of the Project area could increase by 22 percent (16,603 acres [67 km^2]) to achieve wider spacing between WTGs. Alternative D2 would align WTGs in an east–west orientation with a 1-nautical-mile spacing between all turbines to allow greater spacing between WTG rows, which would facilitate the established practice of mobile and fixed-gear fishing vessels. High-resolution geophysical (HRG) surveys would be required as part of pre-construction Project activities under these Alternatives, and some localized temporary acoustic impacts may occur. However, BOEM believes that Level A Harassment or Level B Harassment is unlikely given the PTS distances and the brief duration of the acoustic impacts. Further, individuals are expected to fully recover following the brief exposure to sounds associated with HRG surveys.

During operations and maintenance, Alternatives D1 and D2 would increase the total length of inter-array cables compared to the Proposed Action. BOEM anticipates this difference to increase the potential for long-term EMF-related effects. Since the level of potential impacts from EMF on marine mammals is not well studied, BOEM does not know the extent of any additional long-term impacts associated with additional inter-array cabling required under these Alternatives. BOEM anticipates that all other expected potential direct and indirect impacts associated with Alternatives D1 and D2 would not be measurably different from those anticipated under the Proposed Action (see the Draft EIS Section 3.3.7.6 for details) and would not change the anticipated impact rating (Draft EIS Section 3.3.7.5). Under Alternative E, there would be a 16 percent reduction in the number of WTGs (assuming the installation of no more than 84 WTGs), which would translate into a reduction of pile-driving days, vessel traffic, duration of acoustic impacts, and fewer impacts on water quality and the benthic environment. Additionally, there would be a reduction in WTG and ESP scour protection, inter-array cable, and inter-array cable protection. As such, BOEM anticipates a decrease in potential impacts on marine mammals during construction and installation, operations and maintenance, and decommissioning (Draft EIS Section 3.3.7.6), but these impacts would not be expected to be measurably different than those described under the Proposed Action and would not change the anticipated impact rating. BOEM anticipates the direct and indirect impacts resulting from individual IPFs associated with Alternatives B, C, D1, D2, and E to have potential negligible to moderate impacts and potential minor beneficial impacts on marine mammals associated with Project construction, operations and maintenance, and decommissioning and would not be measurably different than those anticipated under the Proposed Action.

While Alternatives D1 and D2 may be slightly more impactful to marine mammals than the Proposed Action and Alternative E may be slightly less impactful to marine mammals, the cumulative impacts under Alternatives B, C, D1, D2, and E would be similar to those impacts described under the Proposed Action (with individual IPFs leading to impacts ranging from **negligible** to **moderate** and may include **moderate beneficial** impacts). The overall cumulative impacts of Alternatives B, C, D, or E when combined with past, present, and reasonably foreseeable activities on marine mammals within the geographic analysis area would be of the same level as under the Proposed Action—**moderate**. This impact rating is driven mostly by ongoing activities, such as climate change and vessel traffic, as well as by the construction, installation, and presence of offshore wind structures.

3.5.2.3. Direct, Indirect, and Cumulative Impacts of Alternative F

Alternative F analyzes a vessel transit lane through the WDA, in which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The WTGs that would have been located within the transit lane would not be eliminated from the Proposed Action; instead, the displaced WTGs would be shifted to locations south within the lease area. Under this alternative, BOEM is analyzing a 2- and 4-nautical-mile northwest/southeast vessel transit lane through the WDA combined with any action alternative; however, this analysis focuses on the combination of Alternative F with either the Proposed Action or Alternative D2 layout. Therefore, the number of turbines would remain the same. The northern transit lane within the WDA could result in the relocation of 16 to 34 WTG placements, an increased extent of inter-array cables, and a 12 to 61 percent increase in the size of the WDA, (depending on whether the Proposed Action or Alternative D2 layout is used and how wide the transit lane would be). Alternative F, combined with the Proposed Action or Alternative D2 layouts, would potentially lead to a slightly increased risk of resident or migrating marine mammals encountering the WDA or Project-related vessels with associated impacts as described above. Some additional loss of potentially suitable habitat for marine mammal species that avoid the WDA entirely could occur under Alternative F. Additionally, concentrating non-Project vessel traffic into a corridor may result in increased potential for vessel strikes and behavioral responses to vessel noise due to funneling of existing vessel traffic through the transit lane. When compared to the Proposed Action or Alternative D2, the direct and indirect impacts of Alternative F would be slightly increased due to the potential for longer transits to the WDA during construction, operations, and decommissioning, and result in an increase in associated collision risk. However, these impacts resulting from individual IPFs would be expected to still result in **negligible** to **moderate** impacts and potential **minor beneficial** impacts, with no measurable differences to those described under the Proposed Action. This is due to the total number of WTGs and associated impacts remaining the same, and the southern portion of the WDA not including areas with higher densities of marine mammals. The direct and indirect impacts from the combination of Alternative F with the Proposed Action or Alternative D2 are expected to be similar to combinations with the other alternatives. In combination with Alternative C, Alternative F would require six additional WTGs to be relocated. In combination with Alternative E, a reduced number of WTGs would be relocated. Overall, however, Alternative F in combination with these two alternatives would not change the level of impacts on marine mammals described above. Consequently, these other potential combinations are not separately analyzed here.

In considering the cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities, BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The cumulative impacts of Alternative F would not likely be materially different than the cumulative impacts under the Proposed Action (with individual IPFs leading to impacts ranging from **negligible** to **moderate** and may include **moderate beneficial** impacts). The overall cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities would not be expected to be materially different from the Proposed Action—**moderate**. This impact rating is driven mostly by ongoing activities, such as climate change and vessel traffic, as well as by the construction, installation, and presence of offshore wind structures.

BOEM has qualitatively evaluated the cumulative impacts of implementing all six RODA-recommended transit lanes, including the northern transit lane described for Alternative F, as well as five other transit lanes through the RI and MA Lease Areas. To the extent additional transit lanes are implemented in the future outside the WDA as part of RODA's suggestion, the WTGs for future offshore wind projects may need to be located farther from shore, similar to the proposed Project under Alternative F. As discussed in Section 3.4.2, if all the proposed transit lanes were implemented, this would not allow the technical capacity of offshore wind power generation assumed in Chapter 1 to be met. If in the future all six transit lanes were implemented, the overall number of WTGs would likely be less and therefore translate to less pile driving and less temporary noise impacts on marine mammals. Cumulative impacts on marine mammals from six transit lanes may result in slightly greater impacts due to funneling of ongoing non-project related vessel traffic and associated collision risk, but the impacts would be expected to remain the same as a result of the patchy distribution of marine mammals in the geographic analysis area.

3.5.2.4. Comparison of Alternatives

As discussed in Draft EIS Section 3.3.7.8, the expected direct and indirect **negligible** to **moderate** impacts and the potential **minor beneficial** impacts associated with the Proposed Action would not change substantially under Alternatives B through F. While the alternatives have some potential to result in slightly different impacts on marine mammals, the same construction, operations and maintenance, and decommissioning activities would still occur, albeit at differing scales in some cases. Alternatives D1, D2, and F may result in slightly more, but not measurably different, impacts due to an expanded Project footprint and required additional HRG surveys. Alternative E may result in slightly less, but not measurably different, impacts due to a reduced number of WTGs and Project footprint. Therefore, the overall direct and indirect impacts resulting from individual IPFs would range from **negligible** to **moderate** impacts and **minor beneficial** impacts associated with the Proposed Action and would be very similar across all alternatives. Any action alternative would include long-term PAM, the use of PSOs, vessel strike reporting, and pile driving monitoring. Information gained via monitoring could be used to inform Vineyard Wind's decommissioning procedures and could also be used to assist other future offshore wind projects in selecting the least impactful method(s).

Cumulative impacts under any action alternative would likely be very similar because the majority of the cumulative impacts of any alternative come from other future offshore wind development, which does not materially change between alternatives. However, the differences in incremental impacts between action alternatives would still apply when considered alongside the impacts of other ongoing and future activities. Therefore, cumulative impacts on marine mammals would be slightly higher, but not measurably different, under Alternatives D1, D2, and F, and slightly lower, but not measurably different under Alternative E. In any of these cases, the overall level of cumulative impacts on marine mammals resulting from individual IPFs would be slightly greater than the impacts of ongoing, past, present, and reasonably foreseeable activities under the No Action Alternative, and would likely include negligible to moderate impacts due to behavioral avoidance, temporary or permanent displacement, injury, and mortality, and possibly moderate beneficial impacts due to the presence of structures.

In conclusion, the level of cumulative impacts on marine mammals from any alternative, including the No Action Alternative, when combined with past, present, and reasonably foreseeable activities are expected to be moderate. Cumulatively, ongoing activities, the presence of structures, vessel traffic, and climate change are expected to lead to noticeable temporary and permanent impacts across much of the geographic analysis area, of which a small portion is contributed by the Proposed Action. The presence of new structures could benefit some prey species that depend on hard structure and thereby provide increased foraging opportunities for marine mammals within the geographic analysis area.

3.6. Sea Turtles

3.6.1. No Action Alternative Impacts

Table 3.6-1 contains a detailed summary of baseline conditions and the anticipated impacts of ongoing and future offshore activities other than offshore wind on sea turtles, based on IPFs assessed. This information comes primarily from the Draft EIS, supplemented by information developed in response to comments on the Draft EIS, comments from NOAA, and additional information. The impact analysis is limited to the impacts within the geographic analysis area for sea turtles, as described in Table A-1 and shown on Figure A.7-6 in Appendix A.

Five ESA-listed species of sea turtles may occur in the U.S. northwest Atlantic Ocean: leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*), green (*Chelonia mydas*), and hawksbill (*Eretmochelys imbricate*). All of these sea turtles are migratory and enter New England waters primarily in the summer and fall. While in the coastal waters, sea turtles may be found swimming, foraging, migrating, diving at depth for extended periods of time, basking at the surface (Spotila and Standora 1985), and possibly engaged in extended rest periods on the ocean bottom. All sea turtle species in the geographic analysis area are subject to regional, pre-existing threats including, but not limited to, entanglement in fisheries gear, fisheries bycatch, vessel strike, nesting beach impacts, and climate change. In addition, loggerhead, Kemp's ridley, and green sea turtles are susceptible to cold stunning. Commercial fisheries occurring in the southeastern New England region include bottom trawl, midwater trawl, dredge, gillnet, longline, and pots and traps (COP Section 7.8, Volume III; Epsilon 2018a), all of which can lead to impacts on sea turtles due to entanglement and bycatch. Commercial vessel traffic in the region is variable depending on location and vessel type. The commercial vessel types and relative density in the Project region during 2013 includes cargo (low), passenger (high), tug-tow (high), and tanker (low; Epsilon 2018a). This vessel traffic can lead to injury and/or mortality of individuals due to vessel strikes. These ongoing impacts on sea turtles, especially fisheries interactions and commercial vessel traffic, would continue regardless of the offshore wind industry.

Under the No Action Alternative the proposed Project would not be built and hence would have no sea turtle impact. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. If the Vineyard Wind 1 Project were not approved, then impacts from the proposed Project would not occur as proposed. However, the state demand that the Vineyard Wind 1 Project would have filled, if approved, could likely be met by other projects in the geographic analysis area for sea turtles. Therefore, the impacts on sea turtles would be similar, but the exact impact 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 and considers the assumptions included in this SEIS Section 1.2 and Appendix A. A detailed analysis of impacts associated with future offshore wind development is provided in Section 3.6.1.1 and summarized in Table 3.6-1. Cumulative impacts of the Proposed Action and action alternatives are analyzed Section 3.6.2.

3.6.1.1. Future Offshore Wind Activities (without Proposed Action)

BOEM expects these future offshore wind activities to affect sea turtles through the following primary IPFs.

Accidental releases: Accidental releases of fuel/fluids/hazmat, and/or trash and debris may increase as a result of future offshore wind activities. See Section A.8.2 in Appendix for a discussion of the nature of releases anticipated. The risk of any type of accidental release would be increased primarily during construction when additional vessels are present, but also during operations and decommissioning of offshore wind facilities.

In the expanded cumulative scenario, Table A-4 in Appendix A, there would be a low risk of a leak of fuel/fluids/hazardous materials from any single one of approximately 2,021 WTGs, each with approximately 5,000 gallons (18,927 liters) stored. Total fuel/fluids/hazardous material within the geographic analysis area would be approximately 13.1 million gallons (49.6 million liters). According to BOEM's 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 likelihood of a spill occurring from multiple WTGs and ESPs 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. Sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka 2003) or sublethal effects on individual fitness, including adrenal effects, dehydration, hematological effects, increased disease incidence, liver effects, poor body condition, skin effects, skeletomuscular effects, and several other health affects attributed to oil exposure (Camacho et al. 2013; Bembenek-Bailey et al. 2019; Mitchelmore et al. 2017; Shigenaka et al. 2013; Vargo et al. 1986). Additionally, accidental releases may result in impacts on sea turtles due to effects on prey species (Table 3.4-1). Based on the volumes potentially involved, the likely amount of additional releases associated with future 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. BOEM assumes all vessels will comply with laws and regulations to minimize releases. In the unlikely event of a trash or debris release, it would be an accidental, localized event in the vicinity of project areas. Direct ingestion of plastic fragments is well documented an has been observed in all species of sea turtles (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016; Schuylar et al. 2014). In addition to plastic debris, ingestion of tar, paper, Styrofoam, wood, reed, feathers, hooks, lines, and net fragments have also been documented (Thomás et al. 2002). Ingestion can also occur when individuals mistake debris for potential prey items (Gregory 2009; Hoarau et al. 2014; Thomás et al. 2002). Ingestion of marine debris varies among species and life stages due to differing feeding strategies (Nelms et al. 2016). Ingestion of plastics and other marine debris can result in both lethal and sublethal impacts on sea turtles, with sublethal effects more difficult to detect (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Long-term sublethal effects may include dietary dilution, chemical contamination, depressed immune system function, poor body condition as well as reduced growth rates, fecundity, and reproductive success. However, some of these effects are not well understood and clear causal links are difficult to identify (Nelms et al. 2016). While precautions to prevent accidental releases will be employed by vessels and port operations associated with future 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. In the event of a release, it would be an accidental, low-probability event in the vicinity of project areas or the areas from ports to the project areas used by vessels.

EMF: Sea turtles appear to have a detection threshold of magnetosensitivity and behavioral responses to field intensities ranging from 0.0047 to 4000 µT for loggerhead turtles, and 29.3 to 200 µT for green turtles, with other species likely similar due to anatomical, behavioral, and life history similarities (Normandeau et al. 2011). In the expanded cumulative scenario, up to 5,947 miles (9,571 kilometers) of cable would be added in the geographic analysis area for sea turtles, producing EMF in the immediate vicinity of each cable during operations. Submarine power cables in the geographic analysis area for sea turtles are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF from cable operation to low levels. Juvenile and adult sea turtles may detect the EMF over relatively small areas near cables (e.g., when resting on the bottom or foraging on benthic organisms near cables or concrete mattresses). There are no data on impacts on sea turtles from EMFs generated by underwater cables, although anthropogenic magnetic fields can influence migratory deviations (Luschi et al. 2007; Snoek et al. 2016). Lohmann et al. (2008) speculated that navigation methods used by adult and juvenile sea turtles was dependent upon the stage of migration, initially relying on magnetic orientation and then likely using olfactory cues as they near their destination. As such, while EMF associated with offshore wind development submarine cables would likely result in some deviations from a direct route, these deviations would likely be minor (Normandeau et al. 2011), and no biologically significant impacts due to increased energy expenditure would be expected. Further discussion of potential EMF effects on sea turtles is available in the Vineyard Wind BA (BOEM 2019a).

Light: Offshore wind development would result in additional light from vessels and from offshore structures at night. Anthropogenic light sources on the OCS associated with offshore structures or project vessels may result in short-term, low-intensity impacts, including attraction, avoidance, or other behavioral responses, that are expected to be localized and temporary. Potential impacts on sea turtles due to anthropogenic light would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities.

Ocean vessels have an array of lights including navigational, deck, and interior lights. Such lights have some limited potential to attract sea turtles, although the impacts, if any, are expected to be localized and temporary, and would be expected to dissipate once the vessel or the turtle has left the area.

Under the expanded cumulative impact scenario, up to 2,021 WTGs and 45 ESPs would be constructed incrementally over time, beginning in 2022 and continuing through 2030, on the OCS where few lighted structures currently exist. These would have minimal yellow flashing navigational lighting as well as red flashing Federal Aviation Administration (FAA) hazard lights in accordance with BOEM's (2019c) lighting and marking guidelines. BOEM assumes that offshore wind projects will be sited offshore, away from nesting beaches and would not disorient nesting females or hatchling sea turtles. As such, no impacts on these life history stages would be expected. At this time, there is some uncertainty regarding the potential for lighting associated with offshore WTG and ESP platforms to generate sufficient downward illumination to affect sea turtles depending on species or life history stage. However, per BOEM (2019c) guidance, direct lighting would be avoided and indirect lighting of the water surface would be minimized to the greatest extent practicable. In laboratory experiments, captive-reared juvenile loggerhead turtles consistently oriented toward glowing lightsticks of all colors and types used by pelagic longline fisheries (Wang et al. 2019). These results indicate that WTG and ESP lighting may attract loggerhead, and possibly Kemp's ridley and green sea turtles. In a separate study, Gless et al. (2008) determined that juvenile leatherback sea turtles do not appear to be attracted to light. Gless et al. (2008) indicated that most juvenile leatherbacks, in contrast to loggerheads, either failed to orient or oriented at an angle away from the lights. The authors suggested that older, adult turtles might show responses that differ from those of juvenile turtles. Gless et al. (2008) also reviewed previous studies based on fisheries logbook data and concluded that because of confounding factors, there is no convincing evidence that marine turtles are attracted to lights used in longline fisheries. Orr et al. (2013) indicated that lights on wind generators that flash intermittently for navigation or safety purposes do not present a continuous light source, and thus do not appear to have disorientation effects on juvenile or adult sea turtles. Although the potential effects of offshore lighting on juvenile and adult sea turtles is uncertain, WTG lighting is not anticipated to have any detectable effects (adverse or beneficial) on any age class of sea turtles in the offshore environment given the current lack of evidence that platform lighting leads to effects on sea turtles as shown by decades of oil and gas platform operation in the Gulf of Mexico, which can have considerably more lighting than offshore WTGs (BOEM 2019a).

New cable emplacement/maintenance: The impact on water quality from sediment suspension during cable-laying activities is expected to be temporary and short-term. Using the assumptions in Table A-4 in Appendix A, the total area of seafloor disturbed by cable emplacement for offshore wind facilities is estimated to be up to 8,153 acres (33.0 km^2) beginning in 2022 and continuing through 2030. In addition to cables related to individual offshore wind facilities, two unsolicited proposals for the development of two open access offshore transmission systems have been announced. The routes for these proposed regional cables have not been determined at this time and are not considered reasonably foreseeable, but BOEM assumes that if future offshore wind projects use one of these open access transmission systems, the impacts associated with new cable emplacement and maintenance activities would be less than if each individual project installed its own cable. Data are not available regarding effects of suspended sediments on adult and juvenile sea turtles, though elevated suspended sediments may cause individuals to alter normal movements and behaviors. However, these changes are expected to be too small to be detected (NOAA 2020). Sea turtles would be expected to swim away from the sediment plume. Elevated turbidity is most likely to affect sea turtles as a plume causes a barrier to normal behaviors, but no impacts due to swimming through the plume would be expected (NOAA 2020). Turbidity associated with increased sedimentation may result in temporary, short-term impacts on some sea turtle prey species, including benthic mollusks, crustaceans, sponges, sea pens, and crabs (Table 3.4-1). While the cable routes for future offshore wind developments are unknown at this time, the areas subject to increased suspended sediments from simultaneous activities would be limited and all impacts would be localized and temporary. Sediment plumes would be present during construction for 1 to 6 hours at a time. Any dredging necessary prior to cable installation could also contribute additional impacts. Additional impacts related to impingement, entrainment, and capture associated with mechanical and hydraulic dredging techniques could also occur. Mechanical dredging is not expected to result in the capture, injury, or mortality of sea turtles (USACE 2020). Sea turtles are vulnerable to impingement or entrainment in hopper dredges, which can result in injury or mortality. However, the risk of interactions between hopper dredges and individual sea turtles is expected to be lower in the open ocean areas where dredging may occur compared to nearshore navigational channels (Michel et al. 2013; USACE 2020). This may be due to the lower density of sea turtles in these areas as well as differences in behavior and other risk factors. Given the available information, the risk of injury or mortality of individual sea turtles resulting from dredging necessary to support projects considered here is low and population level effects are unlikely to occur.

Noise: Anthropogenic noise on the OCS associated with the future offshore wind development has the potential to result in impacts on sea turtles, including potential auditory injuries, altered submergence patterns, short-term disturbance, startle response (diving or swimming away), and short-term displacement of feeding/migrating and a temporary stress response, if present within the ensonified area (NSF and USGS 2011; Samuel et al. 2005). Potential impacts may occur due to noise from Project aircraft, G&G surveys, operational WTGs, pile driving, cable laying, and vessel traffic.

Future offshore wind development may require the use of helicopters to supplement crew transport during construction and operations. BOEM expects that helicopters transiting to the offshore WDAs would fly at altitudes above those that would cause behavioral responses from sea turtles except when flying low to inspect WTGs or take-off and landing on the SOV. Currently, no published studies describe the impacts of aircraft overflights on sea turtles, though anecdotal reports indicate that sea turtles respond to aircraft by diving (BOEM 2017). While helicopter traffic may cause some short-term and temporary non-biologically significant behavioral reactions, including startle responses (diving or swimming away), altered submergence patterns, and a temporary stress response (BOEM 2017; NSF and USGS 2011; Samuel et al. 2005), these brief responses would be expected to dissipate once the aircraft has left the area.

Without mitigation, G&G surveys for future offshore wind facilities have the potential to result in long-term impacts on sea turtles, including potential auditory injuries, stress, disturbance, and behavioral responses, if present within the ensonified area. The potential for PTS and TTS is considered possible in proximity to active acoustic surveys, but impacts are unlikely as turtles would be expected to avoid such exposure and survey vessels would pass quickly (NSF and USGS 2011). It is important to note that G&G noise resulting from offshore wind site characterization surveys is quieter and affects a much smaller area than G&G noise from seismic surveys used in oil and gas exploration. While seismic surveys create high-intensity impulsive noise to penetrate deep into the seabed, offshore wind site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves that are more similar to common deep-water echosounders. Site characterization surveys for offshore wind facilities would create intermittent noise around sites of investigation over a 2- to 10-year period. Seismic surveys can extend over a time scale of months, as does construction and installation of wind energy structures. However, identifying the locations and schedules of wind energy G&G and construction/installation activities as well as ongoing and future non-offshore wind G&G surveys could avoid overlapping noise impacts by scheduling activities to avoid cumulative impacts on sea turtles. BOEM has concluded that disturbance of sea turtles from underwater noise generated by site characterization and site assessment activities would likely result in temporary displacement and other behavioral or non-biologically significant physiological consequences (BOEM 2019a) and impacts on sea turtles would not result in stock or population-level effects.

Noise associated with operational WTGs, while audible to sea turtles, would not be expected to result in measurable impacts on individuals as the sound pressure levels (SPLs) generated by WTGs would be expected to be at or below ambient levels at a relatively short distance from WTG foundations (Kraus et al. 2016a; Thomsen et al. 2015). According to measurements at the Block Island Wind Farm, low frequency noise generated by turbines reaches ambient levels at 164 feet (50 meters; Miller and Potty 2017). Sound pressure level measurements from operational WTGs in Europe indicate a range of 109 to 127 dB re 1 μPa at 46 and 65.6 feet (14 and 20 meters) from the WTGs (Tougaard et al. 2009). Although sound pressure levels may be different in the local conditions of a project area, if sound levels at the project area are similar, operational noise could be slightly higher than ambient, which ranged from 96 to greater than 103 dB re 1 μPa in the 70.8 to 224 Hz frequency band at the Block Island Wind Facility study area during 50 percent of the recording time between November 2011 and March 2015 (Kraus et al. 2016a). As such, no impacts on individual sea turtles would be expected to occur.

Noise from pile driving would occur during foundation installations for offshore structures for 4 to 6 hours at a time over a 6- to 10-year period. Under the expanded cumulative impact scenario, up to 2,021 WTGs and 45 ESPs would be constructed incrementally over time, beginning in 2022 and continuing through 2030. Sea turtles would be displaced up to 6 hours per day during monopile installation and up to 14 hours per day during jacket installation. Thus, foraging disruptions, if any, would be temporary and are not expected to last longer than a day. This displacement would result in a relatively small energetic consequence that would not be expected to have long-term impacts on sea turtles. Although information is lacking, construction activities could temporarily displace animals into areas that have a lower foraging quality, or result in higher risk of interactions with ships or fishing gear. Potential impacts on sea turtles from multiple construction activities within the same calendar year could affect migration, feeding, breeding, and individual fitness. Intermittent, long-term impacts may be high intensity and high exposure level. The magnitude of these impacts would be dependent upon the locations of concurrent construction as well as the number of hours per day, the number of days that pile driving would occur, and the time of year when pile driving is performed. Individuals repeatedly exposed to pile driving over a season, year, or life stage may incur energetic costs with the potential to lead to long-term consequences (Navy 2018). However, individuals may become habituated to repeated exposures over time and ignore a stimulus that was not accompanied by an overt threat (Hazel et al. 2007), and have been shown to retain this habituation even when the repeated exposures were separated by several days (Bartol and Bartol 2011; Navy 2018).

Noise associated with cable laying would be produced during initial route identification surveys, trenching, jet plow embedment, backfilling, and cable protection installation by vessels and equipment, with intensity and propagation dependent upon bathymetry, local seafloor characteristics, vessels and equipment used (Taormina et al. 2018). Modeling using *in situ* data collected during cable laying operations in Europe estimate that underwater noise would remain above 120 dB re 1 μPa in an area of 98,842 acres (400 km^2) around the source (Bald et al. 2015; Nedwell and Howell 2004; Taormina et al. 2018). Data regarding threshold levels for impacts on sea turtles from sound exposure during construction are very limited, and no regulatory threshold criteria have been established for sea turtles (see Noise from pile driving above for more information). If cable-laying activities were to occur 24 hours per day, the DP vessel would be continually moving along the cable route over a 24-hour period, the area within the 120 dB RMS isopleth would also be constantly moving over the same period. Thus, the estimated ensonified areas would not remain in the same location for more than a few hours and it is unlikely that the sound exposure related to cable-laying activities would result in adverse effects on sea turtles.

The frequency range for vessel noise (10 to 1000 Hz; MMS 2007b) overlaps with sea turtles' known hearing range (less than 1000 Hz with maximum sensitivity between 200 to 700 Hz; Bartol 1994) and would therefore be audible. However, Hazel et al. (2007) suggest that sea turtles' ability to detect approaching vessels is primarily vision-dependent, not acoustic. Sea turtles may respond to vessel approach and/or noise with a startle response (diving or swimming away) and a temporary stress response (NSF and USGS 2011). Samuel et al. (2005) indicated that vessel noise can have an effect on sea turtle behavior, especially their submergence patterns. BOEM anticipates that the potential effects of noise from construction and installation vessels would elicit brief responses to the passing vessel that would dissipate once the vessel or the turtle left the area. Based on the vessel traffic generated by the proposed Project, it is assumed that construction of each individual offshore wind project (estimated to last 2 years per project) would generate an average of 25 and a maximum of 46 vessels operating in the geographic analysis area for sea turtles at any given time, although actual vessel trips would vary by project based on individual project designs and port locations. This increase in vessel traffic and associated noise impacts would be at its peak in 2022 to 2023, when at least five offshore wind projects (not including the Proposed Action) would be under simultaneous construction along the East Coast—i.e., a total of approximately 125 to 230 vessels in the analysis area at any given time during peak construction.[6] Additional information regarding the expected increase in vessel traffic is provided in Section 3.13. This increased offshore wind-related vessel traffic during construction, and associated noise impacts, could result in repeated localized, intermittent, short-term impacts on sea turtles and result in brief behavioral responses that would be expected to dissipate once the vessel or the turtle has left the area. However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of sea turtles and no stock or population-level effects would be expected.

Port utilization: Increases in global shipping traffic and expected increases in port activity along the East Coast from Maine to Virginia will require port modifications to receive the increase in shipping traffic and increased ship size. However, future offshore wind development is expected to be a minor component of port expansion activities required to meet increased commercial, industrial, and recreational demand. The current bearing capacity of existing ports is considered suitable for wind turbines, requiring no port modifications for supporting offshore wind energy development (DOE 2014). Future channel deepening that may be necessary to accommodate larger ships required to carry offshore WTG components and/or increased vessel traffic associated with offshore wind projects may result in increased potential high-intensity impacts including entrainment and vessel strikes, but exposure would be expected to be moderate and risk highly localized to near-shore habitats. At least two proposed offshore wind projects are contemplating port expansion/modification in Vineyard Haven and in Montauk. Other ports would likely be upgraded along the East Coast, and some of this may be attributable to supporting the offshore wind industry. These port expansions would increase the total amount of disturbed benthic habitat, potentially resulting in impacts on some sea turtle prey species. However, the expected disturbance of benthic habitat, and resulting impacts on sea turtles, will likely be a small percentage of available benthic habitat overall. Increases in port utilization due to other offshore wind projects will lead to increases in vessel traffic. This increase will be at its peak during construction activities and will decrease during operations, but will increase again during decommissioning. In addition, any related port expansion and construction activities related to the additional offshore wind projects would add to increased turbidity in the coastal waters.

Presence of structures: The presence of structures can lead to impacts, both beneficial and adverse, on sea turtles through localized changes to hydrodynamic disturbance, prey aggregation and associated increase in foraging opportunities, incidental hooking from recreational fishing around foundations, entanglement in lost and discarded fishing gear, migration disturbances, and displacement. These impacts may arise from buoys, meteorological (met) towers, foundations, scour/cable protections, and transmission cable infrastructure during any stage of a project. Using the assumptions in Table A-4 in Appendix A, the expanded

[6] As specified in Section 1.2, BOEM's analysis of the reasonably foreseeable build-out scenario assumes that the potential vessel availability and supply chain challenges will be overcome and projects will advance as specified in the scenario.

cumulative scenario would include up to 2,066 foundations and 2,944 acres (12 km^2) of new scour protection and hard protection atop cables. Projects may also install more buoys and met towers. BOEM anticipates that structures would be added intermittently over an assumed 6- to 10-year period beginning in 2022, and that they would remain until decommissioning of each facility is complete (30 years).

Manmade structures, especially tall vertical structures such as WTG and ESP foundations, alter local water flow at a fine scale, and could potentially result in localized impacts on sea turtle prey distribution and abundance (Section 3.4.1.1). Water flow typically returns to background levels within a relatively short distance from the structure. Tank tests, such as the one conducted by Miles et al. (2017), conclude that mean flows are reduced immediately downstream of a monopile foundation, but return to background levels within a distance proportional to the pile diameter. For foundations like those proposed by Vineyard Wind, background conditions would return approximately 328 feet (100 meters) away from each monopile foundation. Altered hydraulics can increase seabed scour and sediment suspension around foundations, but BMPs would be in place to minimize scour; therefore, sediment plumes, if any, would return to baseline conditions within a short distance.

The changes in fluid flow caused by the presence of an estimated 2,066 structures could also influence sea turtle prey species at a broader spatial scale. The existing physical oceanographic conditions in the geographic analysis area, with a particular focus on the Southern New England region, are described in Draft EIS Appendix B. Although waters on the OCS experience considerable vertical mixing throughout much of the year, an important seasonal feature influencing sea turtle prey is the cold pool, a mass of cold bottom water in the mid-Atlantic bight overlain and surrounded by warmer water. The cold pool forms in late spring and persists through summer, gradually moving southwest, shrinking, and warming due to vertical mixing and other factors (Chen et al. 2018). During summer, local upwelling and local mixing of the cold pool with surface waters provides a source of nutrients, influencing primary productivity of the ecosystem, which in turn influences finfish and invertebrates (Lentz 2017; Matte and Waldhauer 1984). While there is a high degree of uncertainty, the presence of many WTG structures could affect oceanographic and atmospheric conditions by reducing wind-forced mixing of surface waters and increasing vertical mixing of water forced by currents flowing around foundations (Carpenter et al. 2016; Schultze et al. 2020). During times of stratification (summer), increased mixing could possibly increase pelagic primary productivity in local areas. However, changes in primary productivity might not translate into effects on sea turtle prey species if the increased productivity is consumed by filter feeders, such as mussels, that colonize the surface of the structures (Slavik et al. 2019). The ultimate effects on sea turtle prey species, and therefore sea turtles, of changes to oceanographic and atmospheric conditions caused by offshore structures are not known at this time, and they are likely to vary seasonally and regionally.

The presence of new structures could result in increased prey items for some sea turtle species. WTG and ESP foundations could increase the mixing of surface waters and deepen the thermocline, possibly increasing pelagic productivity in local areas (English et al. 2017). Additionally, hard-bottom (scour control and rock mattresses used to bury required offshore export cables) and vertical structures (i.e., WTG and ESP foundations) in a soft-bottom habitat can create artificial reefs; thus inducing the “reef effect” associated with higher densities and biomass of fish and decapod crustaceans (Causon and Gill 2018; Taormina et al. 2018). Invertebrate and fish assemblages may develop around these reef-like elements within the first year or two after construction (English et al. 2017). Although some studies have noted increased biomass and increased production of particulate organic matter by epifauna growing on submerged foundations, it is not clear to what extent the reef effect results in increased productivity versus simply attracting and aggregating fish from the surrounding areas (Causon and Gill 2018). Recent studies have found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, sea turtles, and birds as well (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019), indicating that offshore wind facilities can generate beneficial permanent impacts on local ecosystems, translating to increased foraging opportunities for sea turtle species. For additional information, see Section 3.4.1.1. The vertical WTG structures may also result in increased primary production and zooplankton, which provide forage for sea turtles and sea turtle prey species.

In the Gulf of Mexico, loggerhead, leatherback, green, Kemp’s ridley, and hawksbill sea turtles have been documented in the vicinity of offshore oil and gas platforms, with the probability of occupation increasing with the age of the structures (Gitschlag and Renauld 1989; Gitschlag and Herczeg 1994; Hastings et al. 1976; Rosman et al. 1987). As such, sea turtles would be expected to use habitat in between the WTGs as well as around structures for feeding, breeding, resting, and migrating for short periods, but residency times around structures may increase with the age of structures if communities develop on and around foundations. Although migrating sea turtles could make temporary stops to rest and feed duration migrations, the presence of structures are not expected to result in noticeable changes to overall migratory patterns in sea turtles. Long-term, high-exposure, low-intensity impacts on foraging and sheltering are expected to be beneficial to sea turtles.

While the anticipated reef effect would be expected to result in beneficial effects on sea turtles, some potential for increased exposure to high intensity risk of interactions with fishing gear that may lead to entanglement, ingestion, injury, and death exists. The presence of structures may indirectly concentrate recreational fishing around foundations, both personal and for-hire, and would also increase the risk of gear loss/damage. This could cause entanglement, and indirectly increase the potential for entanglement in both lines and nets leading to injury and mortality due to abrasions, loss of limbs, and increased drag leading to reduced foraging efficiency and ability to avoid predators (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014). Between 2016 and 2018, 186 sea turtles were documented as hooked or entangled with recreational fishing gear (Table 3.6-2). These data, provided by the Sea Turtle Stranding and Salvage Network, are collected by a network of federal, state, and permitted private partners to identify causes of morbidity and mortality of sea turtles to inform conservation, management, and recovery. Although the reef effect may result in attracting recreational fishing effort from inshore areas, an overall interaction between sea turtles and fisheries resulting from increased effort offshore would not change the overlap in recreational fishing effort and sea turtle distributions in the geographic analysis area. Due to the high number of foundations in a wind development area, it is likely recreational and for-hire fisheries will avoid overcrowding structures by dispersing effort across many WTG foundations. However, the risk of entanglement and ingestion of marine debris could slightly increase since both fishers and turtles may be attracted to the same areas.

Some level of displacement of sea turtles out of the lease areas into areas with a higher potential for interactions with ships or fishing gear during the construction phases of future offshore wind development may occur (Section 3.12). Given the use of structures in the Gulf of Mexico, as described above, no long-term displacement would be expected. Changes in the area of fishing effort are not anticipated with the proposed WTG spacing, but could potentially occur if fisheries choose to operate outside future offshore wind projects. If the area of effort were to change to areas adjacent to offshore wind projects, increased risk would not be expected than already exists within wind areas due to the patchy distribution of sea turtles. The cumulative scenario would impact all fisheries and all gear types (NOAA 2019e). Bottom tending mobile gear is more likely to be displaced than fixed gear. The 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. Given the anticipated 1-nautical mile spacing between WTGs foundations, no changes to gear types would be anticipated. If gear changes were to result from the presence of offshore WTG foundations, additional impacts on sea turtles could occur. However, no new gear types or configurations that could be used have been identified that could result from the presence of these structures.

Increased vessel traffic: Vessel traffic associated with future offshore wind development poses a high frequency, high exposure, collision risk to sea turtles in coastal waters when transiting to and from individual lease areas during construction, operations, and decommissioning. Propeller and collision injuries from boats and ships are common for sea turtles. Vessel strike is an increasing concern for sea turtles, especially in the southeastern United States, where development along the coast is likely to result in increased recreational boat traffic. In the United States, the percentage of strandings of loggerhead sea turtles that were attributed to vessel strikes increased from approximately 10 percent in the 1980s to a record high of 20.5 percent in 2004 (NMFS and USFWS 2007). Sea turtles are likely to be most susceptible to vessel collision in coastal waters, where they forage from May through November. Vessel speed may exceed 10 knots in such waters, and those vessels travelling at greater than 10 knots would pose the greatest threat to sea turtles. As described under the Noise section above, at the peak of Project construction from 2022 to 2023, up to 230 vessels associated with offshore wind development along the East Coast may be operating in the geographic analysis area. However, this vessel traffic increase would be expected to result in only a small incremental increase in overall vessel traffic within the geographic analysis area for sea turtles. Further, collision risk would only be expected when project vessels are transiting to and from the lease areas. Once in the lease areas, vessels would be stationary and no collision risk would be expected. This increased collision risk from transiting project vessels has the potential to result in injury or mortality to individuals but would not be expected to have stock or population-level impacts on sea turtles given their patchy distribution within the geographic analysis area. Further, BOEM assumes that several BMPs relative to sea turtles, including measures to minimize potential vessel impacts, would be implemented during construction, operations, and decommissioning of future offshore wind facilities (Table A-5 in Appendix A).

Climate change: Several sub-IPFs related to climate change, including increased storm severity and frequency; increased erosion and sediment deposition; ocean acidification; altered habitat, ecology, and migration patterns; increased disease frequency; development of protective measures such as seawalls and barriers; and increased sediment erosion and deposition have the potential to result in long-term, high-intensity risk to sea turtles as well as changes to nesting periods, changes in sex ratios of nestlings, and the elimination of potentially suitable habitat or access to potentially suitable habitat (Fuentes and Abbs 2010; Newson et al. 2009; Janzen 1994; Witt et al. 2010). However, future offshore wind development would not be expected to contribute to climate change impacts on sea turtles. A discussion of activities that contribute climate change IPFs are provided in Section A.8.1 in Appendix A.

3.6.1.2. Conclusions

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impacts on sea turtles. BOEM expects ongoing activities and future offshore wind activities to have continuing temporary to permanent impacts on sea turtles, primarily through pile-driving noise, presence of structures, vessel traffic, commercial and recreational fisheries gear interactions, and climate change.

Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in **moderate** adverse impacts because of the presence of structures and pile-driving noise. Additionally, the presence of structures could result in a **moderate beneficial** impact on sea turtles. The majority of offshore structures in the geographic analysis area for sea turtles would be attributable to the offshore wind industry. The offshore wind industry would also be responsible for a majority of the impacts associated with new cable emplacement and EMF, but effects on sea turtles resulting from these IPFs would be localized and temporary, and would not be expected to be biologically significant.

Under the No Action Alternative, there would be no impact on sea turtles from the Proposed Action (described in the Draft EIS Section 3.3.8.3), which would not be built. The resource would continue to follow current regional trends and respond to current and future environmental and societal activities, including the future offshore wind activities assumed in BOEM's scenario. Detailed information regarding the status of sea turtles in the geographic analysis area is provided in BOEM's Draft EIS and the BA submitted to NOAA (BOEM 2019a). The No Action Alternative would forgo the vessel strike reporting and pile-driving monitoring that Vineyard Wind has committed to voluntarily perform, the results of which could provide an understanding of the effects of offshore wind development, benefit future management of these resources, and inform planning of other offshore developments. BOEM acknowledges, however, that other ongoing and future surveys could provide similar data to support similar goals.

3.6.2. Proposed Action and Action Alternatives

3.6.2.1. Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on sea turtles were described in the Draft EIS Section 3.3.8.3, and additional information is included in Table 3.6-1. The Proposed Action would likely result in temporary to permanent impacts that are generally localized and range from **negligible** to **moderate**. The Proposed Action would contribute to impacts through all the IPFs in

Section 3.6.1.1, except port expansion; the Proposed Action would not directly involve port upgrades. 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 would likely include pile-driving noise, which could cause noticeable temporary impacts for 4 to 6 hours at a time during construction, increased vessel traffic, and the presence of structures, which would lead to permanent impacts. Other IPFs would likely contribute impacts of lesser intensity and extent, and would occur primarily during construction, but also during operations and decommissioning.

A total of three IPFs or sub-IPFs in Table 3.6-1 were not previously discussed in the Draft EIS sections regarding sea turtles, including accidental releases, G&G survey noise, and climate change.

The Draft EIS addressed the potential for impacts on sea turtles due to a catastrophic accidental release of oil, but did not contemplate the potential for impacts on individual sea turtles as a result of the accidental releases of fuel, hazardous materials, trash, and debris, and did not contemplate what those impacts may be. Generally, accidental releases of hazardous materials, trash, and debris are expected to be highly localized, rare, and temporary. The proposed Project could lead to an increased potential for a release that may result in localized, rare, and temporary **negligible** impacts, including individual mortality, decreased individual fitness, and health effects (Table 3.6-1). However, all vessels associated with the Proposed Action would comply with the USCG requirements for the prevention and control of oil and fuel spills minimizing impacts on sea turtles resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012a). Trash and debris may also be released by proposed Project vessels during construction, operations, and decommissioning. BOEM assumes operator compliance with federal and international requirements for managing shipboard trash; such events also have a relatively limited spatial impact. While precautions to prevent accidental releases would be employed by vessels and port operations associated with the Vineyard Wind 1 Project, it is likely that some debris could be lost overboard during construction, maintenance, and routine vessel activities. However, the amount would likely be miniscule compared to other inputs. In the event of a release, it would be an accidental, localized event in the vicinity of proposed Project areas, likely resulting non-measurable **negligible** impacts, if any. In addition, BMPs proposed for waste management and mitigation for marine debris, and training and awareness of proposed Project personnel would be required, reducing the likelihood of occurrence to a very low risk.

The Draft EIS also did not consider noise from G&G surveys because it was previously assumed that the Proposed Action would not lead to impacts related to site assessment G&G surveys as these surveys have been completed for the Proposed Action; however, this SEIS now considers the potential impacts of G&G surveys associated with operations, maintenance, and decommissioning activities. G&G surveys associated with the inspection of project cables and foundations after installation and with site clearance activities associated with decommissioning may result in impacts on sea turtles from survey noise. Noise from G&G surveys during inspection and/or monitoring of cables may occur during the proposed Project. G&G survey effort resulting from these post-construction surveys would be shorter in duration and smaller in scope than site investigation surveys in WDAs. The HRG surveys would use only electromechanical sources such as boomer, sparker, and chirp sub-bottom profilers; side-scan sonar; and multi-beam depth sounders. Acoustic signals from electromechanical sources other than the boomer and sparker are not likely to be detectable by sea turtles. The boomer has an operating frequency range of 200 Hz to 16 kHz and could be audible to sea turtles; however, it has very short pulse lengths (120, 150, or 180 microseconds) and a very low source level, with a 180 dB radius of less than 16 feet (5 meters) (BOEM 2014b). Because the potential for injury is small, very brief, and temporary, BOEM anticipates **minor** impacts on sea turtles from HRG noise.

Finally, while the Draft EIS states that some sea turtle species may be susceptible to impacts arising from climate change, no discussion of what those impacts could be was provided. Several sub-IPFs discussed in Table 3.6-1 including increased storm severity and frequency, ocean acidification, altered migration patterns, increased disease frequency, development of protective measures such as sea walls and barriers, and increased erosion and sediment deposition, have the potential to result in long-term, possibly high-consequence risks to sea turtles and could lead to reduced productivity; reduced fitness or mortality of juveniles and adults; changes in prey abundance, availability, and distribution; changes in nesting, breeding and foraging habitat abundance, availability, and distribution; increased disease prevalence and infections; and changes to migration patterns and timing (Fuentes and Abbs 2010; Newson et al. 2009; Janzen 1994; Witt et al. 2010).

Changes to the design capacity of the WTGs to be used would not alter the maximum potential impacts on sea turtles for the Proposed Action and all other action alternatives because the maximum-case scenario involved the maximum number of WTGs (100) specified in the PDE. Changes to the design of the onshore substation would also not alter the potential impacts on sea turtles for the Proposed Action and all other action alternatives because the substation site is inland where sea turtles would not reside.

The cumulative impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are listed by IPF in Table 3.6-1. The nature of the primary IPFs and potential impacts on sea turtles are described in detail in Section 3.6.1.1. Under the No Action Alternative, BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing temporary to permanent impacts on sea turtles, primarily through the following IPFs: accidental releases, G&G survey noise, pile-driving noise, presence of structures, vessel traffic, and climate change.

The cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities would be of similar types as described in Section 3.6.1.1, but may differ in intensity and extent. It is assumed that the energy demand that the Vineyard Wind 1 Project would fill if approved, would likely be met by other projects in remaining areas of the Massachusetts, Rhode Island, and/or New York leases if not approved. Although the impacts from a substitute project may differ in location and time, depending on where and when offshore wind facilities are built out to meet the remaining demand, the nature of impacts and the total number of WTGs would be similar either with or without the Proposed Action, as described in Section 3.6.1.1. In other words, future offshore wind facilities capable of generating 9,404 MW would be built in the RI and MA Lease Areas, although, in the absence of the Proposed Action, none would be built before 2022. Therefore, the cumulative impacts related to WTGs would generally be equal to those described in Section 3.6.1.1. The remainder of this subsection focuses on potential incremental impacts of the Proposed Action that would differ in intensity and/or extent from the No Action Alternative impacts described in Section 3.6.1.1.

Accidental releases: The incremental impacts of the Proposed Action from accidental releases of hazardous materials and trash/debris would not increase the risk beyond that described under the No Action Alternative. Further, the Proposed Action would comply with the USCG 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 Vineyard Wind 1 Project personnel, reducing the likelihood of an accidental release. As such, BOEM anticipates that the Proposed Action would result in negligible impacts, if any, due to the rare, brief, and highly localized nature of accidental releases. Future offshore wind activities would contribute to an increased risk of spills and associated impacts due to fuel, fluid, hazmat, trash, or debris exposure. The contribution from future offshore wind and the Proposed Action would be a low percentage of the overall spill risk from ongoing activities. The cumulative impacts on sea turtles from accidental releases associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be temporary and highly localized due to the likely limited extent and duration of a release, resulting in negligible impacts.

EMF: While EMFs associated with the proposed Project's submerged cables would be detectable by sea turtles, non-measurable, negligible impacts would be expected due to the localized nature of EMFs along the cables near the seafloor, the wide ranges of sea turtles, and appropriate shielding and burial depth. EMF from multiple cables would not overlap, even for multiple cables within a single OECC. The cumulative impacts on sea turtles from EMF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be long-term, but highly localized, resulting in negligible cumulative impacts.

Light: The proposed Project's incremental contribution would be lighting of up to 100 WTGs and two ESPs, all of which would be lit with navigational and FAA hazard lighting. Per BOEM guidance (2019c) and outlined in the COP (Section 3.1.1, Volume I; Epsilon 2020a), each WTG would be lit with two FAA "L-864" aviation red flashing obstruction lights on top of the nacelle, adding up to 200 new red flashing lights to the offshore environment where none currently exist. Additionally, marine navigation lighting will consist of multiple flashing yellow lights on each WTG and on the corners of each ESP. The proposed Vineyard Wind 1 Project is proposing to use an Aircraft Detection Light System (ADLS). The proposed use of red flashing lights would minimize the potential for disorientation effects to adult and juvenile sea turtles (Orr et al. 2013) and the proposed use of ADLS would substantially reduce the amount of light emitted into the environment. As such, BOEM expects impacts on sea turtles, if any, to be long-term, but negligible. Should the Proposed Action involve the use of taller 14-MW WTGs, additional mid-mast lighting would be required, resulting in three additional red flashing FAA aviation obstruction lights per WTG for a total of 285 red flashing lights where none currently exist. Vessel lights during construction, operations, and decommissioning would be minimal and likely limited to vessels transiting to and from construction areas. Under the cumulative impact scenario, up to 2,021 turbines and 45 ESPs would have lights, and these would be incrementally added over time beginning in 2021 and continuing through 2030 on the OCS along the East Coast. Lighting of turbines and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM (2019c) guidance. The cumulative impacts from lighting associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be expected to have negligible, non-measurable cumulative impacts on sea turtles.

New cable emplacement and maintenance activities: The Proposed Action's incremental contribution of up to 328 acres (1.3 km^2) of seafloor disturbance by cable installation and up to 69 acres (0.3 km^2) affected by dredging prior to cable installation would result in turbidity effects that have the potential temporarily affect some sea turtle prey species, including benthic mollusks, crustaceans, sponges, sea pens, and crabs (Sections 3.3 and 3.4). Based on the assumptions in Appendix A Table A-4, only the South Fork Wind Project (OCS-A 0486) would overlap in time with the Proposed Action (2021-2022). However, given the localized nature of these impacts, impacts associated with the emplacement of South Fork Wind's export and inter-array cabling would not overlap spatially with the Proposed Action, and no cumulative impacts would be expected. 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 also generate additional water quality impacts. However, individual sea turtles, 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 temporary and localized nature of the potential impacts (NOAA 2020). Some non-measurable negligible cumulative impacts arising from the Proposed Action when combined with past, present, and reasonably foreseeable activities could occur if impacts occur in close temporal and spatial proximity, though these impacts would not be expected to be biologically significant.

Noise: The various types of expected negligible to moderate impacts on sea turtles due to anthropogenic noise associated with the incremental impacts of the Proposed Action would not increase the impacts of noise beyond the impacts under the No Action Alternative. BOEM expects that helicopters transiting to the Vineyard Wind 1 Project area would fly at altitudes above those that would cause behavioral responses from sea turtles except when flying low to inspect WTGs or to take off and land on the SOV. While helicopter traffic may cause some short-term behavioral reactions in sea turtles (BOEM 2017; NSF and USGS 2011; Samuel et al. 2005), these brief responses would be expected to dissipate once the aircraft has left the area. BOEM expects these impacts to be temporary, short-term, and negligible, resulting in minimal energy expenditure.

Sea turtles would be able to hear the continuous underwater noise of operational WTGs. However, based on the results from Thomsen et al. (2015) and Kraus et al. (2016a), the received SPLs generated by the WTGs are expected to be at or below ambient levels at relatively short distances (164 feet [50 meters]) from the foundations (Miller and Potty 2017). Given that WTG noise would be at or below ambient within a short distance from WTG bases, non-measurable negligible impacts, if any, would be expected.

There is a potential risk of PTS and harassment to sea turtles from pile driving due to the large radial distance to this threshold and maximum impact over the 102 days that pile driving may occur. Vineyard Wind has committed to voluntarily implement measures of using soft start and PSOs would reduce the potential impacts on sea turtles. BOEM anticipates unavoidable, temporary, moderate impacts from the Proposed Action on individual sea turtles from pile driving, given that pile-driving activities would occur over the course of a year. However, these moderate impacts are expected to occur only in a very small number of turtles. There are known occurrences of mortalities associated with pile driving. However, sea turtle anatomy may make them resistant to percussive shock waves (Madin 2009). Based on the low densities of sea turtles in the proposed Project area, soft-starts to allow turtles to leave the area before injurious levels are received, and the implementation of monitoring zones and clearance zones, mortal injury would not be expected to result from the anticipated moderate cumulative impacts associated with pile driving.

According to the Navigational Risk Assessment (NRA; COP Appendix III-I; Epsilon 2018a), current vessel traffic in the Project area and surrounding waters is relatively high, and vessel traffic within the Vineyard Wind lease area is relatively moderate (Section 3.4.7 in the NRA). The NRA for the Project area indicates that the maximum number of vessels during construction would be 46 per day (with an average of 25 per day) (COP Appendix III-I; Epsilon 2018a). This volume of traffic would vary monthly depending on weather and Proposed Action activities. During the period of maximum activity, Proposed Action construction would generate an average of 18 construction vessel trips per day in or out of construction ports. In maximum conditions, this could theoretically include up to 46 trips in a single day, including up to 4 trips per day to or from secondary ports, with the remainder originating or terminating at the New Bedford MCT, compared to the current 25 daily vessel trips measured via AIS in 2011 (COP Appendix III-I; Epsilon 2018a). Potential behavioral impacts on sea turtles from Proposed-Action–related vessel traffic noise would be intermittent and temporary as animals and vessels pass near each other. During construction, impacts are anticipated to be to be minor, with sea turtle populations fully recovering following construction.

The temporary to permanent cumulative impacts from all noise-related impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be expected to range from negligible to moderate. The moderate temporary cumulative impacts that would be expected to result from the pile driving of offshore wind projects would be added to existing noise levels beginning in 2021 and continuing through 2030 along the East Coast. The IPF would be removed from the environment once pile driving stops; behavior of sea turtles is expected to return to normal. However, the effects of PTS may be permanent. Although permanent hearing impairment could occur, hearing ability is not believed to be critical to sea turtles completing essential life history requirements. Affected individuals would not have to adjust their life history strategies in response to PTS.

Port expansion: No port expansion activities are anticipated for the Proposed Action. As such, the Proposed Action would not be expected to appreciably contribute to cumulative impacts on sea turtles.

Presence of structures: The various types of impacts on sea turtles that could result from the presence of structures, such as entanglement and gear loss/damage, fish aggregation and habitat conversion, and avoidance/displacement, are described in detail in Section 3.6.1.1. Using the assumptions in Appendix A Table A-4, there could be up to approximately 2,944 acres (12 km^2) of new hard protection. Of this area, only 151 acres (0.6 km^2) would result from the proposed Project, and the remainder would result from other offshore wind projects in the geographic analysis area. Of the estimated 2,066 structures, 102 would result from the proposed Project. The structures and scour/cable protection, and the potential consequential impacts would remain at least until decommissioning of each facility is complete (30 years). As described above, structures associated with the Vineyard Wind 1 Project would be expected to provide some level of reef effect and may result in long-term minor beneficial impacts on sea turtle foraging and sheltering; however, long-term, minor impacts could occur as a result of increased interaction with active or ghost fishing gear and/or interruptions of important life history behaviors. As part of the Proposed Action, annual monitoring, reporting, and cleanup of fishing gear around the base of the WTGs would be conducted. This would remove any identified fishing gear and reduce the potential for impacts on sea turtles to negligible levels. While the abandoned fishing gear would be removed, the potential for entanglement and/or hooking associated with active commercial or recreational fishing gear would still exist. Overall, the presence of structures associated with the Proposed Action would be expected to result in negligible to minor impacts on sea turtles, as well as potential minor beneficial impacts (Table 3.6-1). The temporary to permanent cumulative impacts resulting from the presence of structures on the OCS associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be expected to range from negligible to moderate, and may include moderate beneficial impacts due to the large number of structures.

Increased vessel traffic: During the proposed Project's most active construction period, Vineyard Wind estimates that a maximum of approximately 46 vessels could operate simultaneously within the WDA or OECC. In an extreme case, all 46 of these vessels could need to travel to or from New Bedford or a secondary port in the same day; however, Vineyard Wind estimates that activities during the proposed Project's most active period would typically generate 18 vessel trips per day to or from ports. The maximum number of vessels involved in the proposed Project at any one time is highly dependent on the Project's final schedule, the final design of the Project's components, and the logistics solution used to achieve compliance with the Jones Act (COP Section 7.8, Volume III, and Appendix III-I; Epsilon 2020a). Vessel traffic associated with the proposed Project poses a high frequency, high exposure collision risk to sea turtles in coastal waters. The Proposed Action would be expected to result in only a small incremental increase in vessel traffic, with a peak during proposed Project construction. However, the NRA (COP Appendix III-I; Epsilon 2018a) found that no significant disruption of normal traffic patterns is anticipated in the WDA associated with the proposed Project. Therefore, even if vessel traffic in the region increases, the Proposed Action is not expected to significantly increase the cumulative risk of vessel allisions or collisions. Given the implementation of project-specific measures, including the use of PSOs, vessel speed restrictions, and the maintenance of turtle avoidance buffers, BOEM anticipates that vessel strikes are highly unlikely and that impacts on sea turtle individuals through this IPF would be expected to be minor, and as such, no population-level impacts would be expected. BOEM anticipates the Proposed Action's potential vessel traffic impacts, when combined with past, present, and reasonably foreseeable activities, could result in moderate cumulative impacts on sea turtles due to injury or mortality to individuals, depending on the exposure duration. However, BOEM does not expect the viability of sea turtle populations to be affected.

Climate change: The surveying, construction, and decommissioning activities associated with the proposed Project would produce GHG emissions that can be assumed to contribute to climate change; however, these contributions would be small (i.e., 6,990 metric tons) compared with the aggregate global emissions. The impact of GHG emissions on sea turtles from the Project would not be detectable. Given that the Proposed Action would produce less GHG emissions than similarly sized fossil-fuel powered generating stations, the cumulative effects associated with the expected reduction in GHG emissions would be expected to result in long-term, low intensity beneficial cumulative impacts on sea turtles.

Other considerations: For temporary impacts, including the effects of pile-driving noise and new cable emplacement, it is likely that a portion, possibly the majority, of such impacts from future activities would not overlap in time with the temporary impacts of the Proposed Action. However, some IPFs that can cause temporary impacts can also cause long-term to permanent impacts.

The cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be several times greater than the incremental impacts of the Proposed Action alone. However, the incremental impacts of the Proposed Action would not add to the impacts of the No Action Alternative because, under the cumulative scenario described in Section 1.2.1, the total capacity of offshore wind development in the geographic analysis area for sea turtles would be the same whether the Proposed Action goes forward or not. BOEM assumes for this cumulative analysis that the number of WTGs would be similar in either case, as would the length of offshore export cable, inter-array cable, and associated disturbances. Thus, the primary differences between the Proposed Action and the No Action Alternative are the locations and times (years) in which the impacts would occur.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from negligible to moderate, and may include moderate beneficial impacts. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in moderate impacts on sea turtles. The main drivers for this impact rating are pile-driving noise and associated potential for auditory injury, the presence of structures, ongoing climate change, and ongoing vessel traffic posing a risk of collision. The Proposed Action would contribute to the overall impact rating primarily through pile-driving noise and the presence of structures. Thus, the overall cumulative impacts on sea turtles would likely qualify as moderate because a notable and measurable adverse impact is anticipated, but the resource would likely recover completely when the impacting agents are removed and remedial or mitigating actions are taken.

3.6.2.2. Cumulative Impacts of Alternative B, C, D1, D2, and E

The incremental impacts associated with Alternative B are described in the Draft EIS Section 3.3.8. BOEM does not expect selection of the landfall location under Alternative B to have any measurable impact on sea turtles compared to the Proposed Action (Draft EIS Section 3.3.8.4). BOEM does not expect that Alternative C would appreciably change the expected potential direct and indirect impacts on sea turtles because the number of turbines would remain the same and the southern portion of the Project area does not include areas with higher densities of sea turtles (Draft EIS Section 3.3.8.5). Under Alternative D1, the total acreage of the Project area could increase by 22 percent (16,603 acres [67 km^2]) to achieve wider spacing between WTGs. Alternative D2 would align WTGs in an east–west orientation with a 1-nautical-mile spacing between all turbines to allow greater spacing between WTG rows, which would facilitate the established practice of mobile and fixed-gear fishing vessels. HRG surveys would be required as part of pre-construction Project activities under these alternatives, and some localized, temporary, acoustic impacts may occur. However, BOEM believes that injury is unlikely given the PTS distances and the brief duration of the acoustic impacts. Further, individuals are expected to fully recover following the brief exposure to sounds associated with HRG surveys. During operations and maintenance, Alternatives D1 and D2 would increase the total length of inter-array cables compared to the Proposed Action. BOEM anticipates this difference to increase the potential for long-term EMF-related effects. Since the level of potential impacts from EMF on sea turtles is not well studied, BOEM does not know the extent of any additional long-term impacts associated with additional inter-array cabling required under these alternatives. BOEM anticipates that all other expected potential direct and indirect impacts associated with Alternatives D1 and D2 would not be measurably different from those anticipated under the Proposed Action (Draft EIS Section 3.3.8.6) and would not change the anticipated impact rating. Under Alternative E, there would be a 16 percent reduction in the number of WTGs (assuming the installation of no more than 84 WTGs), which would translate into a reduction of pile-driving days, vessel traffic, duration of acoustic impacts, and fewer impacts on water quality and the benthic environment. Additionally, there would be a reduction in WTG and ESP scour protection, inter-array cable, and inter-array cable protection. As such, BOEM anticipates a decrease in potential impacts on sea turtles during construction and installation, operations and maintenance, and decommissioning. However, BOEM anticipates the direct and indirect impacts on sea turtles overall would not be measurably different from those anticipated under the Proposed Action. Should larger WTGs be used, a greater reduction in anticipated impacts would be expected (Draft EIS Section 3.3.8.7), but these impacts would not be expected to be measurably different than those described under the Proposed Action and would not change the anticipated impact rating. BOEM anticipates the direct and indirect impacts resulting from individual IPFs associated with Alternatives B, C, D1, D2, or E to have potential negligible to moderate impacts and potential minor beneficial effects associated with the proposed Project construction on sea turtles, and to not be measurably different from those anticipated under the Proposed Action.

While Alternatives D1 and D2 may be slightly more impactful to sea turtles than the Proposed Action and Alternative E may be slightly less impactful to sea turtles, the cumulative impacts under Alternatives B, C, D1, D2, and E would be similar to those impacts described under the Proposed Action (with individual IPFs leading to impacts ranging from negligible to moderate and may include moderate beneficial impacts). The overall cumulative impacts of Alternative B, C, D, or E when combined with past, present, and reasonably foreseeable activities on sea turtles within the geographic analysis area would be of the same level as under the Proposed Action—moderate. This impact rating is driven mostly by ongoing activities, such as climate change and vessel traffic, as well as by the construction, installation, and presence of offshore wind structures.

3.6.2.3. Direct, Indirect, and Cumulative Impacts of Alternative F

Alternative F analyzes a vessel transit lane through the WDA, in which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The WTGs that would have been located within the transit lane would not be eliminated from the Proposed Action; instead, the displaced WTGs would be shifted to locations south within the lease area. Under this alternative, BOEM is analyzing a 2- and 4-nautical-mile northwest/southeast vessel transit lane through the WDA combined with any action alternative; however this analysis focuses on the combination of Alternative F with either the Proposed Action or Alternative D2 layout. Therefore, the number of turbines would remain the same. The northern transit lane within the WDA could result in the relocation of 16 to 34 WTG placements, an increased extent of inter-array cables, and a 12 to 61 percent increase in the size of the WDA, (depending on whether the Proposed Action or Alternative D2 layout is used and how wide the transit lane is). Alternative F, combined with the Proposed Action or Alternative D2 layouts, would potentially lead to a slightly increased risk of resident or migrating sea turtles encountering the WDA, or project-related vessels, with associated impacts, as described above. Additionally, concentrating non-Project vessel traffic into a corridor may result in increased potential for vessel strikes and behavioral responses to vessel noise due to funneling of existing vessel traffic through the transit lane. When compared to the Proposed Action or Alternative D2, the direct and indirect impacts of Alternative F would be slightly increased due to the potential for longer transits to the WDA during construction, operations, and decommissioning, resulting in an increase in associated collision risk, but these impacts resulting from individual IPFs would be expected to still result in **negligible** to **moderate** impacts and potential **minor beneficial** impacts, with no measurable differences to those described under the Proposed Action. This is due to the total number of WTGs, and associated impacts, remaining the same and the southern portion of the WDA not including areas with higher densities of sea turtles. The direct and indirect impacts from the combination of Alternative F with Alternative A or Alternative D2 are expected to be similar to combinations with the other alternatives. Consequently, these other potential combinations are not separately analyzed here.

In considering the cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities, BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The cumulative impacts of Alternative F would not likely be materially different to the cumulative impacts under the Proposed Action (with individual IPFs leading to impacts ranging from **negligible** to **moderate** and may include **minor beneficial** impacts). The overall cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities would not be expected to be materially different from the Proposed Action—**moderate**. This impact rating is driven mostly by ongoing activities, such as climate change and vessel traffic, as well as by the construction, installation, and presence of offshore wind structures.

BOEM has qualitatively evaluated the cumulative impacts of implementing all six RODA-recommended transit lanes, including the northern transit lane described for Alternative F, as well as five other transit lanes through the RI and MA Lease Areas. To the extent additional transit lanes are implemented in the future outside of the WDA as part of RODA's suggestion, the WTGs for future offshore wind projects may need to be located further from shore, similarly to the proposed Project under Alternative F. As discussed in Section 3.4.2, if all the proposed transit lanes were implemented, this would not allow the technical capacity of offshore wind power generation assumed in Chapter 1 to be met. If in the future all six transit lanes were implemented, the overall number of WTGs would likely be less and therefore translate to less pile-driving noise and associated potential for auditory injury. Cumulative impacts on sea turtles from six transit lanes may result in slightly greater impacts due to funneling of ongoing non-project related vessel traffic, but the impacts would be expected to remain the same as a result of the patchy distribution of sea turtles in the geographic analysis area.

3.6.2.4. Comparison of Alternatives

As discussed in Draft EIS Section 3.3.8.9, the expected direct and indirect **negligible** to **moderate** impacts and the potential **minor beneficial** impacts associated with the Proposed Action would not change substantially under Alternatives B through F. While the alternatives have some potential to result in slightly different impacts on sea turtles, the same construction, operations, maintenance, and decommissioning activities would still occur, albeit at differing scales in some cases. Alternatives D1, D2, and F may result in slightly more, but not measurably different, impacts due to an expanded Project footprint and required additional HRG surveys. Alternative E may result in slightly less, but not measurably different, impacts due to a reduced number of WTGs and Project footprint. Therefore, the overall direct and indirect impacts resulting from individual IPFs would range from **negligible** to **moderate** impacts and **minor beneficial** impacts associated with the Proposed Action and would be very similar across all alternatives. Any action alternative would include the use of PSOs, vessel strike reporting, and pile-driving monitoring. Information gained via monitoring could be used to inform Vineyard Wind's decommissioning procedures and could also be used to assist other future offshore wind projects in selecting the least impactful method(s).

Cumulative impacts under any action alternative would likely be very similar because the majority of the cumulative impacts of any alternative comes from other future offshore wind development, which does not materially change between alternatives. However, the differences in incremental impacts between action alternatives would still apply when considered alongside the impacts of other ongoing and future activities. Therefore, cumulative impacts on sea turtles would be slightly higher, but not measurably different, under Alternatives D1, D2, and F, and slightly lower, but not measurably different under Alternative E. In any of these cases, the overall level of cumulative impacts on sea turtles resulting from individual IPFs would be slightly greater than the impacts of ongoing, past, present, and reasonably foreseeable activities under the No Action Alternative, and would likely include **negligible** to **moderate** impacts due to behavioral avoidance, temporary or permanent displacement, injury, and mortality, and may include **moderate beneficial** impacts due to the presence of structures.

In conclusion, the level of cumulative impacts on sea turtles from any alternative, including the No Action Alternative, when combined with past, present, and reasonably foreseeable activities is expected to be **moderate**. Cumulatively, ongoing activities, the presence of structures, vessel traffic, and climate change are expected to lead to noticeable temporary and permanent impacts across much of the geographic analysis area, of which the Proposed Action would contribute a small portion. The presence of new structures could benefit some prey species that depend on hard structure and thereby provide increased foraging opportunities for sea turtles within the geographic analysis area.

3.7. Demographics, Employment, and Economics

3.7.1. No Action Alternative Impacts

Table 3.7-1 contains a detailed summary of the baseline conditions and the impacts of ongoing and future offshore activities other than offshore wind on demographics, employment, and economics, based on the IPFs assessed. This information comes primarily from the Draft EIS, supplemented by information developed in responding to comments on the Draft EIS and additional information. The impact analysis is limited to impacts within the geographic analysis area for demographics, employment, and economics as described in Table A-1 and shown on Figure A.7-7 in Appendix A. Specifically, this includes the counties where proposed onshore infrastructure and potential port cities are located, as well as the counties in closest proximity to the WDA: Barnstable, Bristol, Dukes, and Nantucket counties, Massachusetts; and Providence and Washington counties, Rhode Island.

Most of the geographic analysis area counties display diverse economic activity, while Barnstable, Dukes, and Nantucket counties are notable for their high proportion of seasonal housing and dependence upon tourism and visitors. In Bristol, Providence, and Washington counties, the ocean-based economy sectors are diverse, with a high proportion of shipping and commercial fishing in addition to tourism-related economic activity. Manufacturing and wholesale trade are important to Bristol County's economy, while the Port of New Bedford in Bristol County and Port Judith in Washington County are centers for the regional commercial fishing industry. Generally, BOEM does not anticipate any substantial changes to the distribution of economic sectors in the study area over the Project's proposed lifetime, except for potential substantial increased economic activity associated with future offshore wind activities, as discussed in Section 3.7.1.1. Onshore developments will contribute to ongoing population and economic growth in the region, including residential, commercial, and industrial development, and onshore utility projects that include solar power, transmission, gas pipeline, communications tower, and wind projects. Future offshore activities other than offshore wind would support the existing marine industries and workforce.

Offshore elements of the No Action Alternative are not included in the geographic analysis area, although these elements could produce indirect impacts on demographics, employment, and economics within the geographic analysis area. The direct impacts of the No Action Alternative due to offshore lighting, noise, structures, and other factors that could produce these indirect impacts are described in Sections 3.10, 3.11, 3.13, and the portions of Sections 3.1 through 3.6 that discuss noise, turbidity, vibration, and the presence of structures, along with the corresponding IPF tables in Appendix B.

Under the No Action Alternative, the proposed Project would not be built and hence would have no impact on demographics, employment, and economic resources. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. If the Vineyard Wind 1 Project is not approved, then impacts from the proposed Project would not occur as proposed. However, the state demand that the Vineyard Wind 1 Project would have filled, if approved, could likely be met by other projects in the geographic analysis area for demographics, employment, and economics. Therefore, the impacts on demographics, employment, and economics would be similar, but the exact impact would not be the same due to temporal and geographical differences. The following analysis addresses reasonably foreseeable offshore wind projects that fall within the analysis area and considers the assumptions included in this SEIS Section 1.2 and Appendix A. A detailed analysis of impacts associated with future offshore wind development (excluding the Proposed Action) is provided below and summarized in Table 3.7-1. A detailed analysis of impacts associated with future offshore wind development (excluding the Proposed Action) is provided in Section 3.7.1.1 and summarized in Table 3.7-1. Cumulative impacts of the Proposed Action and action alternatives are analyzed in Section 3.7.2.

3.7.1.1. Future Offshore Wind Activities (without Proposed Action)

BOEM expects these future offshore wind development activities to affect demographics, employment, and economics through the following IPFs.

Energy generation/security: Once built, future offshore wind could produce energy at long-term fixed costs, which could provide a hedge against fossil fuel price volatility. Offshore wind could significantly increase the proportion of energy from renewable sources not subject to fossil fuel costs, with a potential for 9,404 MW of power (32.1 trillion British thermal units [Btu], compared to 72.4 trillion Btu currently provided by renewable sources in Massachusetts) from offshore wind development for Massachusetts and Rhode Island (U.S. Energy Information Administration 2018). A greater share of electricity produced by offshore wind for a given market would also result in a greater need for energy storage and peaker generation capacity, due to anticipated variations in generation. The economic impacts of future offshore wind activities (including associated energy storage and peaker generation capacity projects) on energy generation and energy security cannot be quantified, but would be indirect, long-term, and beneficial.

Light: The aviation warning lighting required for offshore WTGs would be visible from some beaches and coastlines, and could have indirect effects on economic activity in certain locations if the lighting influences visitors in selecting coastal locations to visit, or potential residents in selecting residences. At night, required aviation obstruction lighting on the WTGs would consist of red lights on the nacelle flashing 30 times per minute, as well as mid-tower red lights flashing at the same frequency. A visual impact study provided for the proposed Project states that at distances greater than 14 miles (22.5 kilometers), aviation obstruction lights would be very low on the horizon and would vary in intensity due to the slow flash rate, intermittent shadowing as rotating blades pass in front of the light source, and atmospheric variations. Visibility would be reduced or blocked by fog, snow, or particulate matter (Vineyard Wind 2020). Warning lighting from up to 709 WTGs (out of the 775 assumed as part of the No Action Alternative) could theoretically be visible within the geographic analysis area, depending on viewer location, vegetation, topography, and atmospheric conditions. No readily available studies characterize the impacts of nighttime offshore lighting on economic activity. Studies cited in Draft EIS Section 3.4.4 and in Section 3.10, suggest that WTGs visible from more than 15 miles (24.1 kilometers) away would have negligible effects on businesses dependent on recreation and tourism activity. Up to 34 (out of the 775 assumed as part of the No Action Alternative) of the WTGs envisioned in the RI and MA Lease Areas, less than 5 percent of the total, would be less than 15 miles (24.1 kilometers) from viewers. As a result, although lighting on WTGs would have an indirect, continuous, long-term impact on demographics, employment, and economics, the impact would be limited due to the distant and variable views of nighttime lighting from coastal businesses.

ADLSs are an emerging technology that, if implemented, would only activate aviation warning lighting on WTGs when aircraft enter a predefined airspace. For the Proposed Action, this was estimated to occur 235 times during the year, with a total of 3 hours and 49 minutes (Draft EIS Section 3.4.4). Depending on exact location and layout, ADLS would likely result in similar limits on the frequency of WTG aviation warning lighting use on offshore wind facilities. Implementation of ADLS could thus reduce the amount of time that WTG lighting is visible, thereby making WTG lighting visible only sporadically, rather than continuously at night. This would reduce the indirect impacts on demographics, employment, and economics associated with lighting.

Nighttime construction and maintenance of offshore wind projects would require lighting for vessels in transit and at offshore construction work areas. Concurrent construction of up to four offshore wind projects could occur in 2022 to 2023, all potentially contributing to nighttime vessel lights. Vessel lighting would enable commercial shipping and commercial fishing operations to safely navigate around the vessels and work areas and would be visible from coastal locations, primarily while the vessels are in transit. Vessel lighting is not anticipated to impact the volume of business at visitor-oriented businesses or other businesses. Impacts of vessel lighting would be indirect, localized, short-term, intermittent, and possibly adverse.

New cable emplacement and maintenance: Offshore cable emplacement for future offshore wind would temporarily impact commercial/for-hire fishing businesses based in the geographic analysis area during cable installation and infrequent maintenance. Cable emplacement for offshore wind would occur offshore from the geographic analysis area for demographics, employment, and economics, resulting in about 3,398 acres (13.8 km^2) of seafloor disturbance (based on the assumptions in Appendix A), and fishing vessels may not have access to impacted areas during active construction. The disruption from cable installation may occur concurrently or sequentially, with similar impacts on commercial fishery resources. Disruption may result in conflict over other fishing grounds, increased operating costs for vessels, and lower revenue (e.g., if the substituted fishing area is less productive or supports less valuable species). Short-term productivity reductions would also affect seafood processing and wholesaling businesses that depend upon the fishing industry.

Assuming projects use installation procedures similar to those proposed in the Vineyard Wind COP (Epsilon 2020a), the duration and extent of impacts would be limited. Commercial and for-hire fishing and the related processing industries represent a small portion of the employment and economic activity in the geographic analysis area. The overall impact of cable emplacement and maintenance on commercial/for-hire fishing businesses would be indirect, sporadic, and short-term.

Noise: Noise from site assessment G&G survey activities, operations and maintenance, pile driving, trenching, and vessels could result in indirect, temporary, impacts on employment and economics via the impacts on marine businesses (e.g., commercial fishing, for-hire recreational fishing, and recreational sightseeing).

Noise (especially site assessment G&G surveys and pile driving) would affect fish populations, with indirect effects on commercial and for-hire fishing. As discussed in Sections 3.4 and 3.11, increased noise could temporarily affect the availability of fish within work areas, causing fishing vessels to relocate to other fishing locations in order to continue to earn revenue. This could potentially lead to increased conflict in relocation areas, increased operating costs for vessels, and lower revenue. The severity of such impacts would depend on the overlap of construction activities, where construction activities occur in relation to preferred fishing locations, and how exactly the commercial fishing industry responds to future construction activities.

Population-level impacts on marine mammals would have indirect impacts on employment and economic activity as a result of the impact on marine sightseeing businesses that benefit from the visible presence of marine mammals in the waters offshore from the geographic analysis area. As stated in Section 3.5, noise impacts associated with future offshore wind development could contribute to impacts on individual marine mammals. If multiple project construction activities occur in close spatial and temporal proximity, population level impacts are possible; however, as noted in Section 3.1.9, BMPs can minimize exposure of individual mammals to harmful impacts and avoid population-level effects.

As noted in Section 3.4, noise from trenching and vessel operation is expected to occur, but would have little effect on finfish, invertebrates, and EFH, and therefore little indirect effect on commercial or for-hire fisheries or recreational businesses. Likewise, offshore wind projects may use aircraft for crew transport during maintenance and/or construction; however, aircraft noise is not likely to affect finfish, invertebrates, EFH, or marine mammals. 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 affect finfish, invertebrates, and EFH (English et al. 2017).

Offshore wind-related construction noise from pile driving, cable laying and trenching, and vessels are anticipated to have a direct impact on tour boat and for-hire fishing businesses, making the affected areas temporarily unattractive for the visitor-oriented businesses. Impacts would be localized and temporary.

The overall impact of offshore wind-generated noise on commercial/for-hire fishing businesses or marine sightseeing businesses is anticipated to be both direct, as visitor-oriented services avoid areas of noise, and indirect, resulting from impacts on marine life important for fishing and sightseeing. Operators would adjust their routes and fishing activity to avoid areas of temporary noise impacts, and short-term revenue losses may occur. Both types of impacts would be localized and short-term, 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 in the marine area off the coast of the geographic analysis area. As indicated in Appendix A, Table A-4, the RI and MA Lease Areas could have 775 offshore WTGs and 20 ESPs installed within a 6- to 10-year period, with Project construction beginning in 2022 and continuing through 2030.

Onshore construction noise would temporarily inconvenience visitors, workers, and residents, possibly resulting in a short-term reduction of economic activity for businesses near installation sites for onshore cables, substations, or port improvements. Because the location of onshore improvements is not known and cannot be determined until specific projects are proposed, the magnitude of noise associated with onshore construction and the number of businesses and homes affected cannot be determined. Impacts on demographics, employment, and economics from noise would be indirect, intermittent, and short-term, similar to other onshore utility construction activity.

Port utilization: Future offshore wind development would support investment and employment related to use and expansion of ports and supporting industries in Rhode Island and Massachusetts, including several ports indicated as possibly supporting proposed Project construction: the ports of New Bedford, Montaup, and Brayton Point in Bristol County, ProvPort in Providence County and the Port of Davisville (Quonset Point) in Washington County. Although beyond the scope of this analysis, ports outside the geographic analysis area would also benefit from the economic activity generated by offshore wind. The Massachusetts Clean Energy Center identified 18 waterfront sites in Massachusetts that may be available and suitable for use by the offshore wind industry (MassCEC 2017a), including the Brayton Point and Montaup Power Plant sites (MassCEC 2017a and b), which are retired power plant sites with a long history of industrial (power production) use. Deepwater Wind has committed to improvements to Rhode Island ports in support of the Revolution Wind Project (Kuffner 2018).

Port utilization would require additional shore-based and marine workers, resulting in a trained workforce for the offshore wind industry and contributing to beneficial local and regional economic activity. Where existing ports are improved and channels are dredged for use in support of offshore wind, the improvements would also be beneficial to other port activity. Port utilization in the geographic analysis area associated with offshore wind would occur primarily during development and construction of projects offshore of Massachusetts and Rhode Island, which are anticipated to occur primarily between 2021 and 2030 (Appendix A, Table A-6). Ongoing maintenance and operational support would generate a lower level of port activity and employment once construction is complete.

The port investment and usage generated by offshore wind would have direct, permanent, beneficial impacts on employment and economic activity by providing employment opportunities and supporting marine service industries such as marine construction, ship construction and servicing, and related manufacturing. The most intensive beneficial impacts would occur during construction of offshore wind projects near the geographic analysis area, between 2021 and 2026. The beneficial impact of operational support services for offshore wind and improved port facilities would be long-term but lower in employment and economic activity.

A recent report by the American Wind Energy Association (AWEA 2020) describes recent developments in the offshore wind energy industry and analyzes the potential future economic impacts of the industry. This report lists over $1.3 billion in announced domestic investments in wind energy manufacturing facilities, ports, and vessel construction in Atlantic states. This report also analyzes two scenarios (a base scenario and a high scenario) for the economic impacts associated with wind energy development through 2030. These scenarios estimate the jobs, output, and value added associated with product development and on-site labor impacts, turbine and supply chain impacts, and induced impacts. The offshore wind energy economic and employment impacts would be concentrated in Atlantic coastal states, but would also generate impacts in other parts of the United States. Under the AWEA base scenario, offshore wind energy development would support $14.2 billion in output, $7 billion in value added, and approximately 45,500 jobs by 2030. About 63 percent of total offshore wind energy jobs would support project development and construction, while the remaining 37 percent of jobs would support operations and maintenance.

Under the AWEA high scenario, offshore wind energy development would support $25.4 billion in output, $12.5 billion in value added, and approximately 82,500 jobs by 2030. About 60 percent of total offshore wind energy jobs would support project development and construction, while the remaining 40 percent of the jobs would support operations and maintenance.

Presence of structures: The structures required for future offshore wind, including the 775 WTGs, 20 ESPs, and offshore cables and foundations protected with up to 1,029 acres (4.2 km^2) of hard cover, could indirectly affect employment and economics by affecting marine-based businesses. Commercial fishing operators, marine recreational businesses, and shore-based supporting services (such as seafood processing) could experience both short-term impacts during construction as well as long-term impacts from the presence of structures.

Commercial and for-hire recreational fishing businesses could experience impacts due to higher costs and reduced income during construction, operations and maintenance, and decommissioning, resulting from the need to adjust routes and fishing grounds to avoid offshore construction areas, as well as operational WTGs and ESPs during operations. Allisions could lead to vessel damage and spills, which could have direct costs (i.e., vessel repairs and spill cleanup) as well as indirect costs from damage caused by spills. Sections 3.11 and 3.3, respectively, discuss impacts on commercial or for-hire recreational fishing and navigation. In addition to the impact from the need to avoid structures and the complexities of navigating through the developed offshore wind projects, the scour protection and foundations of offshore wind structures could provide new opportunity for for-hire recreational fishing businesses and certain types of commercial fishing by attracting certain fish through the reef effect (Section 3.11).

Commercial fishing businesses would also be affected by the use of concrete mattresses to cover cables in hard-bottom areas during offshore wind operation. Commercial trawlers/dredgers would need to be aware of and avoid the locations of concrete cable coverage to avoid potential gear loss, damage, or entanglement. The long-term impacts of concrete cable protection on commercial fishing businesses would be indirect, and localized. Operators would be able to adjust to avoid affected locations, but the complexity of selecting fishing areas, and the areas where trawling or dredging methods cannot be used without possible gear loss would increase as the extent of hard coverage area increases.

Offshore wind structures could also hinder the current routes of commercial vessels providing offshore recreational services, although many such businesses would be able to adjust by changing routes with limited effects. The presence of WTGs could require adjustment of vessel routes used for activities such as sailboat races, tour boat routes, and recreational fishing.

Long distance sailing races that traverse the waters offshore of the geographic analysis area, such as the Transatlantic Race, Marion to Bermuda Race, and Newport Bermuda Race, generate business for visitor services within the geographic analysis area. These races may vary in their routes and only occur every 2 to 4 years, so impacts of offshore wind construction areas and permanent structures would depend upon the particular locations where construction would occur or be completed at the time of a specific race. With advance communication and planning, races could be routed to avoid offshore wind construction areas or structures.

For-hire fishing businesses that target Highly Migratory Species (HMS) such as tuna, shark, and marlin more likely to be impacted, because these fisheries are more likely to overlap areas where offshore wind development would occur (as opposed to other fisheries, which tend to occur closer to shore). While HMS angling has fewer participants and trips than most coastal recreational fishing, HMS anglers often spend significantly more than other fishing participants on individual fishing trips and tournaments. There were 20,020 vessels with a permit for Atlantic HMS in 2016 (NOAA 2019b).

The fish aggregation and reef effects of up to 413 acres (1.7 km^2) of hard coverage around offshore wind structures would also provide new opportunities for recreational fishing. Aggregation and reef effects would impact a minority of recreational fishing vessels that travel as far from shore as offshore wind structures (Section 3.10), and would therefore generate minimal economic activity. Although the likelihood of recreational vessels visiting offshore foundations would vary based on relative proximity to shore, increasing offshore wind development could change recreational fishing patterns within the larger socioeconomic study area, as the tourist industry learns to make use of the structures.

In summary, offshore wind structures and hard coverage for cables would have indirect, long-term impacts on commercial fishing operations and support businesses such as seafood processing. The impacts would increase in intensity as more offshore structures are completed, but the fishing industry would be able to adjust fishing practices over time. The offshore structures would also necessitate alterations in the routes of for-hire recreational fishing, recreational tour boat businesses, sailing races, and HMS angling. Some offshore wind structures would provide new business opportunities due to fish aggregation and reef effects—which could attract fish valued for recreational fishing—and the possibility of tours for visitors interested in a close-up view of the wind structures, as has occurred for the Block Island Wind Farm.

The views of offshore WTGs could have indirect impacts on businesses serving the recreation and tourism industry. Impacts could be adverse for particular locations if visitors and customers avoid certain businesses (i.e., hotels or rental dwellings) due to views of the WTGs; impacts could be neutral or beneficial if views do not affect visitor decisions or influence some visitors beneficially. As discussed in Section 3.10, portions of up to 775 WTGs would theoretically be visible from beaches and coastal areas in the geographic analysis area for demographics, employment, and economics.

Overall, the presence of offshore wind structures would have a continuous, long-term impact on employment and economics.

Vessel traffic and vessel collisions: Offshore wind construction and decommissioning and, to a lesser extent, offshore wind operations would generate increased vessel traffic. This additional traffic would support increased employment and economic activity for marine transportation and supporting businesses, investment in the ports of New Bedford, Montaup, Brayton Point, ProvPort and Davisville (Quonset Point), and investment in other ports outside of the geographic analysis area (the port utilization IPF discusses the AWEA report). Increased vessel traffic would have continuous, beneficial impacts during all project phases, with stronger impacts during construction and decommissioning.

Impacts of short-term increased vessel traffic during construction could include increased vessel traffic congestion, delays at ports, and a risk for collisions between vessels. As stated in Section 3.13, future offshore wind projects would result in a small incremental increase in vessel traffic, with a short-term peak during construction. Increased vessel traffic would be localized near affected ports and offshore construction areas. Congestion and delays could increase fuel costs (i.e., for vessels forced to wait for port traffic to pass), and could decrease productivity for commercial shipping, fishing, and recreational vessel businesses, whose income depends on the ability to spend time out of port. Collisions could lead to vessel damage and spills, which could have direct costs (i.e., vessel repairs and spill cleanup) as well as indirect costs from damage caused by spills.

The magnitude of increased vessel traffic is described in more detail in Section 3.13, and would depend upon the vessel traffic volumes generated by each offshore wind project, the extent of concurrent or sequential construction of wind energy projects, and the ports selected for each project. Increased vessel traffic congestion and collision risk would have indirect, continuous, and short-term impacts during all project phases, with stronger impacts during construction and decommissioning.

Land disturbance: Offshore wind development would require onshore cable installation, substation construction or expansion, and possibly expansion of shore-based port facilities. Depending on siting, land disturbance could result in localized, temporary disturbances of businesses near cable routes and construction sites for substations and other electrical infrastructure, due to typical construction impacts such as increased noise, traffic, and road disturbances. These impacts would be similar in character and duration to other common construction projects, such as utility installations, road repairs, and industrial site construction. Impacts on employment would be localized, temporary, and both beneficial (jobs and revenues to local businesses that participate in onshore construction) and adverse (lost revenue due to construction disturbances).

Climate change: Climate change could have impacts on demographics, employment, and economics. Property or infrastructure damage, resulting from sea level rise and increased storm severity/frequency, could lead to increased insurance costs and reduced economic viability of coastal communities. Efforts to construct protective barriers and sea walls would generate employment, but would require substantial public funding requiring either new taxes or diversion of existing tax revenue from current uses. Erosion and deposition of sediments could damage structures, infrastructures, beaches, and coastal land, with numerous economic impacts. Ocean acidification, altered habitats, altered migration patterns and increased disease frequency in marine species would have potential impacts on commercial and for-hire fishing, individual recreational fishing, and sightseeing.

Because the future offshore wind facilities would produce less GHG emissions than fossil-fuel-powered generating facilities with similar capacities, the reduction in GHG emissions due to future offshore wind projects (or avoidance of increased GHG emissions from equivalent fossil-fuel-powered energy production) would result in long-term beneficial impacts on demographics, employment, and economics. Section A.8.1 describes the expected contribution of offshore wind to climate change.

3.7.1.2. Conclusions

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impact on demographics, employment, and economics. BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to continue to support growth of the geographic analysis area's diverse economy, based on anticipated population growth and ongoing development of businesses and industry. Tourism and recreation would continue to be important to the economies of the coastal areas, and especially of Barnstable, Nantucket, and Dukes counties. Marine industries such as commercial fishing and shipping would continue to be small but active components of the regional economy.

Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in overall **minor** adverse impacts. These impacts would primarily be indirect, resulting from direct impacts on finfish and invertebrates and marine mammals, and the presence of structures within areas currently available for navigation. These direct impacts on would indirectly affect the employment and economics of the commercial and for-hire fishing industry, businesses reliant upon marine recreation and tourism, and shore-based businesses that support these marine industries.

BOEM also anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in overall **minor** beneficial impacts. Development of offshore wind activities in the geographic analysis area would support new employment and economic activity (above and beyond economic trends), through the development and expansion of ports, shipping, and related industries; employment resulting directly and indirectly from offshore wind; support for manufacturing, service, transportation, and other businesses that would support offshore wind; and the development of a trained offshore wind industry workforce. Sections 3.4, 3.5, 3.10, 3.11, and 3.13 discuss the cumulative impacts on resource areas that would affect employment and economics.

3.7.2. Proposed Action and Action Alternatives

3.7.2.1. Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on demographic, employment, and economic resources were described in Draft EIS Section 3.4.1.3, and additional information is included in Table 3.7-1 in this SEIS. Changes to the design capacity of the WTGs proposed in the Vineyard Wind COP (Epsilon 2020a), as compared to the WTGs evaluated in the Draft EIS, would alter the maximum potential economic impact for the Proposed Action and all other action alternatives. If Vineyard Wind were to install 57 14-MW WTGs instead of the potential 100, 8-MW WTGs initially evaluated, the reduced spending associated with the reduced number of turbines would decrease employment, tax revenue, and economic output. Compared to the 8-MW WTG technology evaluated in the Draft EIS, use of 14-MW WTGs and 1 to 2 ESPs would have the following effects (Vineyard Wind 2020):

- Reduction in employment generated by Proposed Action construction: 14 percent reduction in Massachusetts statewide, 15 percent reduction in southeastern Massachusetts;
- Reduction in economic output, expenditures, and economic value-added generated by the Proposed Action operation and maintenance: 9 percent reduction in both Massachusetts and southeastern Massachusetts; and
- Reduction in tax revenue from the Proposed Action during Development, Construction, and First-Year Operations and Maintenance: 7.5 percent reduction.

Vineyard Wind notes two other revisions to the original Proposed Action that would affect the Proposed Action's economic impact. First, the delay in obtaining federal authorization for the Proposed Action has increased the development and pre-construction period by 2 years. This delay increases the Project's development, pre-construction, and consultant jobs by an estimated 100 FTEs per year for 2 years, regardless of the development scenario selected. The 2-year permitting delay approximately offsets changes in employment and non-labor expenditures of the 57 WTG scenario compared to the pre-construction and construction estimates for the 100 WTG scenario provided in the Vineyard Wind COP (COP Appendix III-L; Epsilon 2018a). (However, the estimated 100 FTEs supported by Vineyard Wind during the 2-year delay also applies to the 100 WTG scenario. The employment and economic impacts for the 100 WTG scenario would be greater than the 2017 estimates when accounting for the 2-year permitting delay.) Secondly, although the estimate of jobs during operations and maintenance is based on a 25-year operational period, Vineyard Wind is requesting a 30-year operational period, which would increase the overall number of jobs and expenditures (Vineyard Wind 2020). Increasing the size of the proposed substation by 2.2 acres (<0.1 km^2), as described in Chapter 2 would not change the analysis of impacts on demographics, employment, and economics for the Proposed Action and all other action alternatives, as described in the Draft EIS.

Because of the lower employment, economic output, and tax revenue, the 14-MW WTG option represents the scenario that would produce the smallest beneficial economic benefit. As a conservative measure, this section therefore evaluates the cumulative economic impacts of the Proposed Action with the 14-MW WTG option. The Proposed Action would have long-term, **minor beneficial** impacts on employment and economic activity in the study area, due to anticipated job creation, expenditures on local businesses, generation of tax revenues, and provision of grant funds resulting from the Proposed Action. The Proposed Action would have **negligible** impacts on demographics and housing within the study area. Both short-term construction and long-term operation of the Proposed Action would have **minor** to **moderate** impacts on recreation and tourism (Section 3.10), and commercial/for-hire fishing (Section 3.11) would have **minor** to **moderate** impacts on the businesses associated with those activities.[7]

The cumulative impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are listed by IPF in Table 3.7-1. The most impactful beneficial IPFs would include port utilization and expansion, while the most impactful IPFs would include temporary noise during construction and the presence of offshore structures.

[7] The Draft EIS concluded that the Proposed Action would have minor impacts on commercial fishing; however, analyses conducted following publication of the Draft EIS determined that the magnitude of these impacts would be moderate.

The nature of the primary IPFs affecting demographics, employment, and economics, and the cumulative impacts including the Proposed Action would be of the same types described in Sections 3.7.1.1 and 3.7.1.2. The cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities would be of similar types as described in Section 3.7.1, but may differ in intensity and extent. If the proposed Project is not approved, it is assumed that the energy demand that the proposed Project would have filled would likely be met by other projects in remaining areas of the Massachusetts, Rhode Island, and/or New York leases. Although the impacts from a substitute project may differ in location and time, depending on where and when offshore wind facilities are built out to meet the remaining demand, the nature of impacts and the total number of WTGs would be similar either with or without the Proposed Action, as described in Section 3.7.1.1. In other words, future offshore wind facilities capable of generating 9,404 MW would be built in the RI and MA Lease Areas, although, in the absence of the Proposed Action, none would be built before 2021. Therefore, the cumulative impacts related to WTGs would generally be equal to those described in Section 3.7.1.1.

Light: Nighttime lighting for vessels in transit and in the offshore work area would occur when Project construction or maintenance takes place at night. Vessel lighting would be visible from shore primarily for ships in transit; vessel lighting at the offshore work area may be discernible from shore from very limited locations (Vineyard Wind COP Appendix III.H.a; Epsilon 2018a). Short-term vessel lighting is not anticipated to discourage tourist-related business activities and would not impact other businesses; therefore, lighting from the Proposed Action would have indirect, short-term, negligible impacts. Vessel lighting from other offshore wind projects would have similar impacts as the Proposed Action, but at different locations and times. If lighting from Proposed Action vessels occurred simultaneously, the cumulative impacts of this lighting on demographics, employment, and economics would also be indirect, short-term, and negligible.

The permanent aviation safety lighting required for the Proposed Action's WTGs could be visible from beaches and coastal locations on Martha's Vineyard and Nantucket, possibly resulting in indirect effects on employment and economics in these areas if the lighting discourages visits or vacation home rental or purchases in coastal locations where the Proposed Action's WTG lighting is visible. As described in Section 3.10.2, lighting from all the Proposed Action's WTGs could theoretically be visible from onshore locations. Vineyard Wind has committed to voluntarily implement ADLS (as described in Draft EIS Section 3.4.1.3) as a voluntarily measure, which would activate the Proposed Action's WTG lighting when aircraft approach the Vineyard Wind 1 Project WTGs, which is expected to occur less than 0.1 percent of annual nighttime hours. This lighting would have an indirect, continuous, long-term, negligible impact on demographics, economics, and employment in the geographic analysis area.

In addition, as stated in Section 3.7.1.1, the lights on 652 WTGs associated with other offshore wind projects (in addition to 57 WTGs from the Proposed Action—a total of 709 out of the 775 WTGs) could also be visible. Section 3.2.14.1 concludes that lighting from the Proposed Action, in combination with the No Action Alternative, would have a minor impact on recreation and tourism. As a result, the Proposed Action, in combination with the No Action Alternative would have a continuous, long-term, negligible to minor cumulative impact on demographics, employment, and economics. If implemented for offshore wind projects other than the Proposed Action, ADLS would reduce the economic impacts associated with WTG lighting to negligible.

New cable emplacement and maintenance: Offshore cable emplacement for the Proposed Action would impact approximately 233 acres (0.9 km^2) of seafloor, which could temporarily impact commercial/for-hire fishing businesses during cable installation and infrequent maintenance. Cable installation would reduce income and increase costs for vessels that need to relocate away from work areas, would disrupt fish stocks near the installation locations, and would prevent the deployment of fixed gear in the work area. Installation of the Proposed Action's cables would have localized, short-term, minor impacts. All specific cable locations associated with future offshore wind projects have not been identified in the waters offshore from the geographic analysis area with the exception of the Vineyard Wind 2 Project cable, which would use the same offshore cable corridor as the Proposed Action. Overall, cable emplacement for the No Action Alternative (including the Proposed Action) would impact over 3,398 acres (13.8 km^2). Based on the cumulative assumptions in Appendix A, these cables would not be installed simultaneously with the Proposed Action; therefore, the Proposed Action, in combination with the No Action Alternative would have a short-term, minor cumulative impact on demographics, employment, and economics.

Noise: The Proposed Action's incremental contribution to noise from G&G survey activities, operations and maintenance, pile driving, trenching, and vessels would have direct and indirect, intermittent, short-term, negligible impacts on visitors, workers, and residents. Pile driving associated with the Proposed Action and South Fork Wind Project could overlap for up to 2 weeks, which could result in cumulative noise impacts on fish and marine mammals, as discussed in Sections 3.4, 3.5, and 3.11. These direct cumulative impacts would have indirect cumulative impacts on the fishing and sightseeing businesses that rely on these species.

The Proposed Action's onshore construction noise activities are not anticipated to overlap in location with other offshore wind projects, and therefore would not produce cumulative impacts.

Port Utilization, Expansion, and Maintenance/Dredging: The Proposed Action would make use of the state's ongoing investment in the MCT at the Port of New Bedford, as well as private investments at Vineyard Haven Harbor, but was not itself the impetus for any such investments. As stated in Draft EIS Section 3.4.6.3, these upgrades were undertaken in support of the Massachusetts/ Rhode Island offshore wind industry as a whole. Employment and economic benefits of the Proposed Action at the Port of New Bedford and Vineyard Haven would have long-term, minor beneficial impacts, but would be a component of, and not additive to, the overall cumulative economic impact at these ports described for the No-Action Alternative in Sections 3.7.1.1 and 3.7.1.2. The Proposed Action would not require maintenance dredging at any port. As a result, there would be no cumulative impacts on demographics, employment, and economics from this IPF.

Presence of structures: As described above, the maximum-case scenario for the Proposed Action assumes the installation of 57 14-MW WTGs and up to 2 ESPs. The Proposed Action's direct and indirect impacts on employment and economics for marine-based businesses (i.e., commercial and for-hire recreational fishing businesses, offshore recreational businesses, and related businesses) would be continuous, long-term, minor to moderate impacts, and both direct and indirect.

As described in Section 3.11.2, the offshore structures resulting from the Proposed Action, including 57 WTGs, 2 ESPs, and approximately 109 acres (0.4 km^2) of hard coverage for WTG and ESP foundations and cable protection could affect commercial fisheries and for-hire recreational fishing due to impacts such as entanglement and gear loss/damage, navigational hazard and risk of allisions, fish aggregation, habitat alteration, effort displacement, and space use conflicts. Similar impacts would affect recreational fishing and marine sightseeing (Section 3.10.2). Hard coverage would include approximately 31 acres (0.1 km^2) of scour protection around WTG and ESP foundations that could have fish aggregation and reef effects, which would also provide new opportunities for recreational fishing. Cumulatively, the amount of hard protection for structures and cabling offshore from the geographic analysis area would be up to 1,029 acres (4.2 km^2), which could indirectly affect employment and economics by affecting marine-based businesses.

As described in Section 3.10.2, portions of all of the Proposed Action's WTGs could theoretically be visible from beaches and coastal locations on Martha's Vineyard, Nantucket, and Cape Cod, in addition to portions of all WTGs associated with other offshore wind projects. As discussed in Section 3.7.1.1, views of WTGs could have indirect impacts on businesses serving the recreation and tourism industry.

Due to the presence of offshore wind structures, the Proposed Action, in combination with the future offshore wind projects would have an indirect, long-term, **moderate** cumulative impact on demographics, employment, and economics, due to direct impacts on commercial and for-hire recreational fishing, for-hire recreational boating, and associated businesses.

Vessel Traffic and Vessel Collisions: The Proposed Action would generate vessel traffic in the Port of New Bedford, as well as at Vineyard Haven Harbor. In addition, the Proposed Action could affect vessel traffic in Lewis Bay if the New Hampshire Avenue cable landfall site is selected. The Proposed Action's incremental contributions to increased employment and economic activity for marine transportation and supporting businesses in the geographic analysis area would have direct, continuous, short-term, and **minor beneficial** impacts during construction and decommissioning, and **negligible** impacts during operations. The Proposed Action's contributions to impacts on marine businesses associated with vessel traffic congestion and delays at ports, and the risk for collisions between vessels, would be indirect, continuous, short-term, and **minor** in magnitude during construction (**moderate** if the New Hampshire Avenue cable-landing site and OECC route through Lewis Bay is selected), and **negligible** during operations.

The increased congestion and collision risk in Lewis Bay would have an incremental impact specific to the Proposed Action only due to the potential location of its OECC. This increased risk would be temporary, occurring only during OECC installation. While not specifically proposed, use of a Lewis Bay landfall site for other offshore wind projects could result in similar impacts, resulting in greater congestion; this scenario is possible if multiple OECC cables are installed in Lewis Bay concurrently.

Increased vessel traffic from the Proposed Action, in combination with past, present, and reasonably foreseeable activities would have indirect, continuous, **beneficial** impacts on employment and economics during all project phases, with **minor** impacts during construction and decommissioning and **negligible** impacts during operations. Increased vessel traffic congestion and collision risk from the Proposed Action in combination with past, present, and reasonably foreseeable activities would have indirect, long-term, and continuous impacts on marine businesses during all project phases, with **minor** impacts during construction and decommissioning and **negligible** impacts during operations.

Land Disturbance: Construction of the Proposed Action would require onshore cable installation and substation construction in the Hyannis area. The direct and indirect employment and economic impact of the Proposed Action caused by disturbance of businesses near the onshore cable route and substation construction site would result in indirect, localized, short-term, **minor** impacts. These impacts would be cumulative only if land disturbance associated with one or more other projects occurs in close spatial and temporal proximity to the Proposed Action. In such cases the Proposed Action, in combination with past, present, and reasonably foreseeable activities would have an indirect, short-term, **minor**, cumulative impact on demographics, employment, and economics, due to the short-term and localized disruption of onshore businesses.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from **negligible** to **moderate** impacts and **negligible** to **minor beneficial** impacts. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with past, present, reasonably foreseeable activities would result in **minor** impacts and **minor beneficial** impacts on demographics, employment, and economics in the geographic analysis area. The main drivers for this impact rating include minor adverse and beneficial cumulative impacts associated with aviation hazard lighting on WTGs, new cable emplacement and maintenance, the presence of structures, vessel traffic and collisions during construction, and land disturbance. The Proposed Action would contribute to the overall impact rating primarily through short-term impacts from vessel traffic and potential collisions, long-term impacts from the presence of structures (WTGs and ESPs), and beneficial impacts from new hiring and economic activity. Indirect, **moderate** impacts are anticipated due to direct impacts on commercial and for-hire recreational fishing (Section 3.11.2), but these impacts would only be a component of the overall impacts on this resource. Thus, the overall cumulative impacts on demographics, employment, and economics would likely qualify as **minor**, because it is expected that these impacts would not disrupt normal or routine demographic characteristics, employment, or economic activity in the geographic analysis area—or that, in the case of temporary economic activity specifically associated with construction, any such changes would generally revert to pre-construction conditions following construction completion. There would also be **minor beneficial** cumulative impacts on demographics, employment, and economics due to a small and measurable benefit from construction and operations-phase employment and economic improvement.

3.7.2.2. Cumulative Impacts of Alternatives B, C, D1, D2, and E

The direct and indirect impacts of Alternatives B, C, D1, D2, and E on demographics, employment, and economics are described in Draft EIS Sections 3.4.1.4 and 3.4.1.5. These impacts, revised to reflect the use of 14-MW WTGs, are summarized below:

- The difference between Alternative B and the Proposed Action is the selection of Covell's Beach as the landfall site and the resultant avoidance of impacts on businesses and economic activity in and near Lewis Bay. In other respects, the direct and indirect impacts of Alternative B on demographics, employment, and economics would be the same as the Proposed Action.
- The differences in the WTG layouts used for Alternatives C, D1, and D2 would not alter the Project's impacts on demographics, employment, and economics described for the Proposed Action.
- Under Alternative E, the Project would include up to 84 WTGs using a combination of 9- to 10-MW WTGs, compared to 57 14-MW WTGs for the Proposed Action. Under Alternative E, the manufacture, installation, and decommissioning of the larger number of turbines would result in a slightly larger construction workforce, labor spending, total direct expenses, and tax revenues than the Proposed Action. The increased number of WTGs (compared to the 14-MW option) would incrementally complicate navigation through the WDA, marginally increasing potential adverse economic impacts on commercial fishing and recreational businesses that navigate through the WDA. As a result, the direct and indirect impacts of Alternative E on demographics, employment, and economics, both beneficial and adverse, would be marginally stronger than those of the Proposed Action, but would likely remain similar in overall impact.

Accordingly, the direct and indirect impacts resulting from individual IPFs associated with Alternatives B, C, D1, D2, and E on demographics, employment, and economics would be the same as those of the Proposed Action: **negligible** to **moderate** impacts due to the IPFs discussed above, along with **negligible** to **minor** beneficial impacts due to new hiring and economic activity.

The cumulative impacts resulting from individual IPFs associated with Alternatives B, C, D1, D2, and E when combined with past, present, and reasonably foreseeable activities, would be very similar to those of the Proposed Action; **negligible** to **moderate** impacts on demographics, employment, and economics along with **negligible** to **minor beneficial** impacts due to new hiring and economic activity; because the majority of the cumulative impacts come from other offshore wind projects, and the direct and indirect impacts of each alternative would be very similar to those of the Proposed Action.

The overall cumulative impacts of each alternative when combined with past, present, and reasonably foreseeable activities on this resource within the geographic analysis area would be of the same level as under the Proposed Action—**minor** and **minor beneficial**. This impact rating is primarily driven by the construction, installation, and presence of offshore wind structures, and the increased risk of vessel allision and collision.

3.7.2.3. Direct, Indirect, and Cumulative Impacts of Alternative F

Alternative F analyzes a vessel transit lane through the WDA, within which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. Under this alternative, BOEM is analyzing a 2- and 4-nautical-mile northwest/southeast vessel transit lane through the WDA combined with any action alternative; however, this analysis focuses on the combination of Alternative F with either the Proposed Action or Alternative D2 layout. The northern transit lane within the WDA could result in the relocation of 16 to 34 WTG placements and a 12 to 61 percent increase in the size of the WDA and an increase in the amount of inter-array cables (depending on whether the Proposed Action or Alternative D2 layout is used). The direct and indirect impacts of Alternative F on demographics, employment, and economics would vary based on the width of the transit lane and the underlying layout used, as discussed below.

The primary differences between the Proposed Action and the combination of Alternative F and the Proposed Action would be the establishment of an up to 4 nautical-mile-wide northern transit lane through the WDA resulting in the following changes in impacts, compared to the Proposed Action alone:

- Reduced impacts from IPFs related to allisions and collisions due to the presence of a transit lane parallel to (or crossing perpendicularly) the approximate predominant orientation of WTGs. Implementation of a 4-nautical-mile transit lane would reduce impacts more than a 2-nautical-mile transit lane, but neither reduction in impact would change the overall **moderate** impact on demographics, employment, and economics from this IPF.
- Marginally reduced impacts from IPFs related to the visibility of WTG structures and hazard lighting because some of the Proposed Action's WTGs would be farther from shore, reducing the number of WTGs and lights potentially visible, and thereby incrementally reducing the economic impacts of visible WTGs. This would include 9 WTGs moved farther away from shore if a 2-nautical-mile transit lane were established, and 27 WTGs located farther away if a 4-nautical-mile transit lane were established. Due to the distance between the WDA and onshore viewers, these relocations would not change the indirect **minor** to **moderate** impacts of visual changes on demographics, employment, and economics already described for the Proposed Action.

Impacts from other IPFs under Alternative F with the Proposed Action would remain the same as or substantially similar to those of the Proposed Action. As a result, direct and indirect impacts resulting from individual IPFs associated with Alternative F would have **negligible** to **moderate** impacts on demographics, employment, and economics; as well as **negligible** to **minor beneficial** impacts.

The primary differences between Alternative D2 and the combination of Alternative F with Alternative D2 would be the establishment of an up to 4 nautical-mile-wide northern transit lane through the WDA resulting in the following changes in impacts, compared to the Alternative D2 alone:

- Increased impacts from IPFs related to allisions and collisions. The presence of a transit lane would facilitate travel for vessels seeking to pass through the entire WDA, reducing the likelihood of allisions and collisions. However, the northwest-southeast transit lane orientation would differ from the east-west orientation of Vineyard Wind 1 WTGs and the preferred east-west orientation of commercial fishing. In addition, some commercial and recreational fishing and boating could occur within the transit lane. These direct impacts would lead to increased indirect impacts on demographics, employment, and economics, although the indirect impact magnitude would remain **moderate**, with both a 2-nautical-mile and 4-nautical-mile-wide transit lane.

- Marginally reduced impacts from IPFs related to the visibility of WTG structures and hazard lighting, because some of the Proposed Action's WTGs would be farther from shore, reducing the number of WTGs and lights potentially visible, thereby incrementally reducing the economic impacts of visible WTGs. This would include 16 WTGs moved farther away from shore if a 2-nautical-mile transit lane were established, and 33 WTGs located farther away if a 4-nautical-mile transit lane were established. Due to the distance between the WDA and onshore viewers, these relocations would not change the indirect **minor** to **moderate** impacts of visual changes on demographics, employment, and economics already described for Alternative D2.

Impacts from other IPFs under Alternative F with Alternative D2 would remain the same as or substantially similar to those of Alternative D2 alone. As a result, direct and indirect impacts resulting from individual IPFs associated with Alternative F would have **negligible** to **moderate** impacts on demographics, employment, and economics, as well as **negligible** to **minor beneficial** impacts.

The impacts from the combination of Alternative F with Alternatives B, C, D1, and E are expected to be similar to those described for Alternative F with the Proposed Action.

Because the majority of the cumulative impacts of any alternative come from other offshore wind projects, the cumulative impact resulting from individual IPFs associated with Alternative F would remain the same as for the Proposed Action, **negligible** to **moderate** impacts on demographics, employment, and economics. The beneficial impacts would remain **negligible** to **minor beneficial**, but would be smaller than under the Proposed Action. The overall cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities on this resource within the geographic analysis area would be of the same level as under the Proposed Action—**minor** and **minor beneficial**. This impact rating is primarily driven by the construction, installation, and presence of offshore wind structures, and the increased risk of vessel allision and collision.

BOEM has qualitatively evaluated the cumulative impacts of implementing all six RODA-recommended transit lanes, including the northern transit lane described for Alternative F, as well as five other transit lanes through the RI and MA Lease Areas. To the extent additional transit lanes are implemented in the future outside the WDA as part of RODA's suggestion, the WTGs for future offshore wind projects may need to be located farther from shore, similar to the proposed Project under Alternative F. As a result, establishment of these additional transit lanes could require longer vessel trips for all phases of future projects and longer timeframes time for cable installation. Collectively, these effects would result in greater impacts on demographics, employment, and economics overall than if Alternative F were not implemented, due to increased impacts on marine species of interest to marine businesses from cable installation, and increased risk of vessel collision (due to the increased distance traveled). Moreover, as stated in Section 2.2.2, if all transit lanes suggested by RODA were implemented, the technical capacity of offshore wind power generation in the RI and MA Lease Areas would not be met. This would result in economic impacts substantially higher than those if Alternative F were not implemented.

3.7.2.4. Comparison of Alternatives

As discussed in Draft EIS Section 3.4.1.7, and except as discussed below, most alternatives are effectively identical in terms of the level of impact on demographics, employment, and economics: **negligible** to **moderate** impacts on demographics, economics, and employment (due to the individual IPFs discussed above), along with **negligible** to **minor beneficial** impacts (due to new hiring and economic activity). Alternative B would avoid the direct and cumulative impacts on economic activity near Lewis Bay by eliminating the New Hampshire Avenue cable landfall site and the associated OECC and onshore cable route, but would still have a range from the individual IPFS of **negligible** to **moderate** impacts on demographics, economics, and employment. As compared to the revised Proposed Action, with 57 14-MW WTGs, installing 57 to 84 WTGs under Alternative E would have slightly larger beneficial employment and economic impacts due to increased construction workforce, labor spending, total direct expenses, and tax revenues; and slightly larger employment and economic impacts associated with navigation complexity for commercial and for-hire recreational fisheries. Alternative F, in combination with the Proposed Action layout, would have smaller direct and indirect impacts on demographics, employment, and economics, due to reduced impacts associated with structures and vessel collision. These differences would result in incrementally different impacts, but would not change the overall magnitude of direct and indirect impacts described for the Proposed Action. Alternative F, in combination with the Alternative D2 layout, would have larger direct and indirect impacts on demographics, employment, and economics, due to increased impacts associated with structures and vessel collision. These differences would result in incrementally different impacts, but would not change the overall magnitude of direct and indirect impacts described for the Proposed Action.

Cumulative impacts under any action alternative other than Alternatives B and F would likely be very similar because the majority of the cumulative impacts of any alternative come from other future offshore wind development, which does not change between alternatives; however, the differences in direct and indirect impacts between action alternatives would still apply when considered alongside the impacts of other ongoing and future activities. Therefore, cumulative impacts on demographics, employment, and economics would be slightly lower under Alternative B and Alternative F with the Proposed Action layout, and slightly higher under Alternative F with the Alternative D2 layout than under the maximum-case scenario in other action alternatives. In any of these cases, the range of cumulative impacts resulting from individual IPFs from any action alternative would likely include **negligible** to **moderate** impacts on demographics, economics, and employment (due to the IPFs discussed above), along with **negligible** to **minor beneficial** impacts (due to new hiring and economic activity).

In conclusion, the overall cumulative impacts on demographics, employment, and economics from any action alternative, when combined with past, present, and reasonably foreseeable activities would be **minor** and **minor beneficial**. This impact rating is primarily driven by the construction, installation, and presence of offshore wind structures, and the increased risk of vessel allision and collision.

3.8. ENVIRONMENTAL JUSTICE

3.8.1. No Action Alternative Impacts

Table 3.8-1 contains a detailed summary of the baseline conditions and the impacts of ongoing and future offshore activities other than offshore wind on environmental justice populations, based on the IPFs assessed. This information primarily comes from the Draft EIS, supplemented by information developed in responding to comments on the Draft EIS and additional information. The impact analysis is limited to impacts within the geographic analysis area for environmental justice as described in Table A-1 and shown on Figure A.7-7 in Appendix A. Specifically, this includes the counties where proposed onshore infrastructure and potential port cities are located, as well as the counties in closest proximity to the WDA: Barnstable, Bristol, Dukes, and Nantucket counties, Massachusetts; and Providence and Washington counties, Rhode Island.

Environmental justice communities or populations are those whose proportion of low-income or minority residents is meaningfully higher than that of the corresponding state. By definition, beneficial impacts are not environmental justice impacts; however, this section describes beneficial impacts on environmental justice communities, where appropriate, for completeness.

The Commonwealth of Massachusetts identifies an environmental justice community as U.S. Census block groups that meet one or more of the following criteria (Commonwealth of Massachusetts 2017):

- 25 percent of households within the census block group have a median annual household income at or below 65 percent of the statewide median income for Massachusetts;
- 25 percent or more of the residents are minority; or
- 25 percent or more of the residents have English Isolation.[8]

Using this definition, environmental justice communities in the Massachusetts portion of the geographic analysis area are clustered around larger cities and towns, and occur in Hyannis, New Bedford, and Fall River, which contain populations that meet both the income and minority criteria. Environmental justice communities meeting the minority population criterion are present in south-central Nantucket County near Cisco and the Nantucket airport. In Dukes County, communities meeting the income and minority/English isolation criteria for environmental justice are present near Vineyard Haven, and a minority population is present near Aquinnah. Additional environmental justice communities occur on Cape Cod and scattered throughout southeastern Massachusetts.

Rhode Island has no state definition for environmental justice analyses. The Draft EIS used United States Environmental Protection Agency (USEPA) guidance to define an environmental justice community as U.S. Census block groups that have at least 50 percent minority population or that are in the 80th or higher percentile within the state for minority or low-income status. Environmental justice communities meeting the minority and income criteria are present within and near Providence and Newport.

Table 3.8-2 summarizes trends for non-white populations and the percentage of residents with household incomes below the federally defined poverty line in the counties studied in Massachusetts and Rhode Island.[9] The non-white population percentage and percentage of population living under the poverty level have generally increased since 2000 in nearly all study area jurisdictions.

In addition to the geographic locations of environmental justice communities, low-income workers are found within the commercial fishing industry, service industries that support tourism, and supporting industries. Ongoing onshore development supports employment and economic development that may benefit some lower income workers. Offshore projects would provide continuing support for employment within the geographic analysis area for environmental justice populations in marine trades, vessel and port maintenance, and supporting industries.

Under the No Action Alternative, the proposed Project would not be built and hence would have no impact on environmental justice populations. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. If the Vineyard Wind 1 Project is not approved, then impacts from the proposed Project would not occur as proposed. However, the state demand that the Vineyard Wind 1 Project would have filled, if approved, could likely be met by other projects in the geographic analysis area for environmental justice populations. Therefore, the impacts on environmental justice populations would be similar, but the exact impact would not be the same due to temporal and geographical differences. The following analysis addresses reasonably foreseeable offshore wind projects that fall within the analysis area and considers the assumptions included in Section 1.2 and Appendix A. A detailed analysis of impacts associated with future offshore wind development (excluding the Proposed Action) is provided in Section 3.8.1.1 and summarized in Table 3.8-1. Cumulative impacts of the Proposed Action and action alternatives are analyzed in Section 3.8.2.

3.8.1.1. Future Offshore Wind Activities (without Proposed Action)

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

Air emissions: Increased port activity would generate short-term, variable increases in air emissions. As stated in Section A.8.1 in Appendix A, 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

[8] Indicates households defined by the U.S. Census as being English Language Isolated or that do not include an adult who speaks only English or English very well (Commonwealth of Massachusetts 2017).

[9] Available census data for 2000 and 2010 do not distinguish between white and non-white Hispanic individuals, and do not compare median household income at the state and block group levels. The percentage of non-white individuals and the percentage of the population with incomes below the federal poverty level ("Percentage of Population in Poverty") are therefore used as proxies for "minority" and "low income" environmental justice criteria.

environmental justice communities. However, environmental justice communities near ports could experience disproportionate air quality impacts depending upon the ports that are used, ambient air quality, and the increase in emissions at any given port.

Table A-4 in Appendix A identifies 12 future offshore wind projects other than the Proposed Action that could be constructed off the coast of Massachusetts and Rhode Island. Possible overlapping construction periods as estimated in Table A-4 in Appendix A could result in up to four projects under construction at one time. Vineyard Wind 1 construction could be supported by three ports near environmental justice communities: the ports of Providence, Quonset-Davisville, and New Bedford. Although beyond the scope of this analysis, the Massachusetts Clean Energy Center identified 18 waterfront sites in Massachusetts that may be available and suitable for use by the offshore wind industry (MassCEC 2017a, b), which may include others in close proximity to environmental justice communities. Deepwater Wind has committed to improvements to Rhode Island ports in support of the Revolution Wind Project (Kuffner 2018).

Based on the assumed construction schedule presented in Table A-6 in Appendix A, projects within the geographic analysis area for environmental justice populations would have overlapping construction periods beginning in 2022 and continuing through 2030. As stated in Section A.8.1 in Appendix A, during the construction phase, total emissions of criteria pollutants (nitrogen dioxide$_2$, sulfur dioxide [SO_2], carbon monoxide [CO], particulate matter with diameters 10 microns and smaller [PM_{10}], particulate matter with diameters 2.5 microns and smaller [$PM_{2.5}$], and volatile organic compounds [VOCs]) would be approximately 44,795 tons throughout the air quality geographic analysis area. This area is larger than the environmental justice geographic analysis area, extending from the coastline out to and including the offshore work areas for the RI and MA Lease Areas. Thus, a large portion of the emissions would not be generated near environmental justice communities, but along the vessel transit routes and at the offshore work areas. Emissions of nitrogen oxides (NO_X) and CO are primarily due to diesel construction equipment, vessels, and commercial vehicles.

Emissions would vary spatially and temporally during construction phases even for overlapping projects. Emissions from vessels, vehicles, and equipment operating in ports could affect environmental justice communities adjacent or close to those ports. Emissions attributable to the No Action Alternative affecting any neighborhood have not been quantified; however, it is assumed that emissions from the No Action Alternative at ports would comprise a small proportion of total emissions from those facilities. Therefore, air emissions during construction would have small, short-term, variable impacts on environmental justice communities 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 communities would be less.

As explained in Section A.8.1 in Appendix A, operation of the No Action Alternative would generate approximately 650 tons per year of criteria pollutants, primarily NO_x (482 tons per year) and CO (123 tons per year). Emissions would largely be due to commercial vessel traffic 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 operating within and near the three ports identified above would affect environmental justice communities. Therefore, during operations of offshore wind projects, the air emissions volumes resulting from port activities are not anticipated to be large enough to have impacts on environmental justice communities.

Net reductions in CO_2 emissions resulting from offshore wind development would result in long-term benefits to communities (regardless of environmental justice status) by displacing emissions from fossil fuel-generated power plants (Section A.8.1 in Appendix A).

Light: The view of nighttime aviation warning lighting required for offshore wind structures could have indirect impacts on economic activity in locations where lighting is visible, by affecting the decisions of tourists or visitors in selecting coastal locations to visit. Because the service industries that support tourism are a source of employment and income for low-income workers, impacts on tourism would also result in impacts on environmental justice populations.

As additional offshore wind projects become operational, the nighttime lighting would be visible from a greater number of coastal locations. As noted in Section 3.10.1.1 and Draft EIS Section 3.4.4.3, nighttime views of aviation hazard lighting for WTGs can affect the value of properties with views of this lighting. The visibility of WTGs more than 15 miles (24 kilometers) offshore is anticipated to have negligible impacts on recreation and tourism overall. The aviation hazard lighting from approximately 709 (out of 775) WTGs could potentially be visible from beaches and coastal areas in the environmental justice geographic analysis area, depending on vegetation, topography, weather, and atmospheric conditions; up to 34 of the WTGs could be less than 15 miles (24 kilometers) from the coast. The magnitude of impacts from aviation hazard lighting is not specifically stated in the Draft EIS; rather, aviation hazard lighting is evaluated as part of the overall discussion of the Proposed Action's visual impacts on recreation and tourism in Draft EIS Section 3.4.4.3. The impacts on recreation and tourism-related economic activity, if any, would be long term and continuous, and could, in turn, have indirect impacts on environmental justice populations, specifically low-income employees of tourism-related businesses.

Lighting impacts would be reduced if the emerging technology of ADLS is used. ADLS lighting would be activated only when an aircraft approaches (Section 3.7.1). For the Proposed Action, this was estimated to occur during less than 0.1 percent of total annual nighttime hours (Draft EIS Section 3.4.4). Depending on exact location and layout of offshore wind projects other than the Proposed Action, ADLS would likely result in similar limits on the frequency of WTG aviation warning lighting use. This technology, if used, would significantly reduce the already low-level impacts of lighting on employment in tourism-related service industries.

New cable emplacement/maintenance: Cable emplacement for wind projects offshore from the geographic analysis area for environmental justice would result in about 3,400 acres (13.7 km^2) of seafloor disturbance. Specific cable locations have not been identified offshore from the geographic analysis area with the exception of the Vineyard Wind 2 Project cable, which would use the same offshore cable corridor as the proposed Project. Assuming future projects use installation procedures similar to those proposed in the Vineyard Wind COP, cable emplacement could displace other marine activities for a period of 1 day to several months within cable installation areas.

As described in Sections 3.7.1.1 and 3.11.1.1, cable installation and maintenance would have localized, temporary, short-term, impacts on the revenue and operating costs of commercial and for-hire fishing businesses. Commercial fishing operations may temporarily be less productive during cable installation or repair, resulting in reduced income and also leading to short-term reductions in business volumes for seafood processing and wholesaling businesses that depend upon the commercial fishing industry. Although the commercial and for-hire fishing businesses could temporarily adjust their operating locations to avoid revenue loss, the impacts would be greater if multiple cable installation or repair projects are underway offshore of the environmental justice geographic analysis area at one time. Business impacts could have impacts on environmental justice populations due to the potential loss of income or jobs by low-income workers in the commercial fishing industry. In addition, cable installation and maintenance could temporarily disrupt subsistence fishing, resulting in short-term, localized impacts on low-income residents who rely on subsistence fishing as a food source.

Noise: As described in greater detail in Section 3.7, noise from site assessment G&G survey activities, pile driving, trenching, and vessels is likely to result in temporary revenue reductions for commercial fishing and marine recreational businesses that operate in the areas offshore from the geographic analysis area for environmental justice populations. Construction noise, especially site assessment G&G surveys and pile driving, would affect fish and marine mammal populations, with indirect impacts on commercial and for-hire fishing and marine sightseeing businesses. The potential impacts on fish and marine mammals are described in Sections 3.4, 3.5, and 3.11. 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/for-hire fishing and marine tours.

The localized impacts of offshore noise on fishing could also have an impact on subsistence fishing by low-income residents. In addition, noise would directly affect some for-hire fishing businesses or marine sightseeing businesses, as these visitor-oriented services are likely to avoid areas where noise is being generated due to the disruption for the 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. As indicated in Table A-4 in Appendix A, the Rhode Island and Massachusetts projects offshore from the geographic analysis area for environmental justice could have a total of 775 offshore WTGs and 20 ESPs installed within a 6- to 10-year period. The impacts of offshore noise on marine businesses and subsistence fishing would have short-term, localized impacts on low-income workers in marine-dependent businesses or residents who rely on subsistence fishing, resulting in impacts on environmental justice populations. It is anticipated that most construction activities would take place in the summer due to more favorable weather conditions. Thus, commercial fisheries most active in the summer will likely be impacted more than those in the winter.

Onshore construction noise would temporarily inconvenience visitors, workers, and residents near sites where onshore cables, substations, or port improvements are installed to support offshore wind. Impacts would depend upon the location of onshore construction in relation to businesses or environmental justice communities. Impacts on environmental justice communities could be short term, and intermittent, similar to other onshore utility construction activity.

Noise generated by offshore wind staging operations at ports would potentially have impacts on environmental justice communities if the port is located near such communities. Within the geographic analysis area for environmental justice populations, the ports of Providence, Quonset-Davisville, and New Bedford are within or near environmental justice communities. The noise impacts from increased port utilization would be short term and variable, limited to the construction period, and would increase if a port is used for multiple offshore wind projects during the same time period. Noise impacts would be reduced if intervening buildings, roads, or topography lessen the intensity of noise in nearby residential neighborhoods, or if noise reduction mitigations are used for motorized vehicles and equipment.

Port utilization: Expansion: The ports of Providence, Quonset-Davisville, and New Bedford are within or near environmental justice communities. Impacts would result from increased air emissions and noise generated by port utilization or expansion (see discussions above under Air Emissions and Noise).

Port use and expansion resulting from offshore wind would have beneficial impacts on employment at ports. For ports within older urban centers in the geographic analysis area for environmental justice populations, such as Providence and New Bedford, recent economic trends have resulted in declining employment in manufacturing industries. Port utilization for offshore wind would have short-term, continuous, beneficial impacts for environmental justice populations during construction and decommissioning, including direct impacts (employment opportunities) and indirect impacts, resulting from the support for other local businesses by the port-related businesses and employee expenditures. Beneficial impacts would also result from port utilization during offshore wind operations, but these impacts would be of lower magnitude.

Presence of structures: As described in Sections 3.7 and 3.10, the offshore structures required for offshore wind projects, including WTGs, ESPs, and offshore cables protected with hard cover, would indirectly affect employment and economic activity generated by marine-based businesses.

Commercial fishing businesses would need to adjust routes and fishing grounds to avoid offshore work areas during construction, and to avoid WTGs and ESPs 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. For-hire recreational fishing businesses would also need to avoid construction areas and offshore structures. Businesses that serve HMS recreational fishing are more likely to be affected, because these fisheries are more likely to overlap areas where offshore wind development would occur (as opposed to other fisheries, which tend to occur closer to shore). Sailing races (including, but not limited to the Transatlantic Race, Marion to Bermuda Race, and Newport Bermuda Race) may need to be re-routed, affecting the shore-based businesses that serve these interests.

A decrease in revenue, employment, and income within commercial fishing and marine recreational industries is likely to impact low-income workers, resulting in impacts on environmental justice populations. The impacts during construction would be indirect, continuous, and short term, and would increase in magnitude when multiple offshore construction areas exist at the same time. (As many as four offshore wind projects could be under construction simultaneously in the waters offshore from the geographic analysis area). Impacts during operations would be long term and continuous, but may lessen in magnitude as business operators adjust to the presence of offshore structures and the larger marine safety zones needed for construction are no longer in effect.

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

Views of offshore WTGs could also have indirect impacts on individual locations and businesses serving the recreation and tourism industry, based on visitor decisions to select or avoid certain locations. Because the service industries that support tourism are a source of employment and income for low-income workers, impacts on tourism would also result in impacts on environmental justice populations. As stated in Section 3.10.1, portions of all 775 WTGs associated with the No Action Alternative could potentially be visible from shorelines, depending on vegetation, topography, weather, and atmospheric conditions. While WTGs could be visible from some shoreline locations in the geographic analysis area, WTGs would not dominate offshore views, even when weather and atmospheric conditions allow views. The impact of visible WTGs on recreation and tourism is likely to be limited to individual decisions by some visitors and is unlikely to affect most shore-based tourism businesses or the geographic analysis area's tourism industry as a whole (Section 3.10.1 provides more details). Therefore, views of offshore WTGs are not anticipated to result in impacts on environmental justice populations, specifically low-income employees of tourism-related businesses.

Traffic: vessels: Offshore wind construction and decommissioning and, to a lesser extent, offshore wind operation would generate increased vessel traffic. As stated in Section 3.10, future offshore wind projects would result in vessel traffic from as many as four projects under construction concurrently offshore from the geographic analysis area. Vessel traffic for each project is not known; however, as an example, the Vineyard Wind 1 Project is projected to generate an average of 7 daily vessel trips between ports and offshore work areas over the entire construction phase, and an average of 18 vessel trips daily during peak construction activity (Vineyard Wind COP Appendix III-I, Section 5.2.2; Epsilon 2018a).

The volume of vessel traffic during construction would complicate marine navigation in the offshore construction areas and create the potential for vessel congestion and reduced capacity within and near the ports that support offshore construction, with potential competition for berths and docks. The temporary impacts on commercial fishing or recreational boating would affect all local boaters, and would not have disproportionate impacts on residents or businesses within areas identified as environmental justice communities; however, the impact may be of greater magnitude for individuals who fish for subsistence or members of environmental justice communities who depend on jobs in commercial/for-hire fishing or marine recreation (including seafood processing and packing industries) for their livelihood. Simultaneous development of multiple offshore wind could increase port-related vessel congestion. However, the impacts could be reduced by appropriate port planning and preparation. The New Bedford Marine MCT was built to support the wind industry. The city of New Bedford's Plan details goals for improvement of facilities to support commercial fishing, shipping, and recreational boating, providing for the full range of port users in addition to offshore wind (Sasaki et al. 2016). Therefore, use of the MCT and nearby industrial sites to support the proposed Project would not displace existing businesses.

Accordingly, vessel traffic generated by offshore wind project construction would have indirect, short-term, variable impacts on environmental justice communities due to the impacts on jobs, income, and subsistence fishing resulting from impacts on marine businesses, port congestion, and availability of berths. The magnitude of impact would depend upon the navigation patterns and the extent of facility preparation and planning at the particular port. In addition to the temporary impacts related to navigation and port availability, the increased need for marine transportation to support offshore wind could have beneficial impacts on environmental justice populations through the provision of jobs and support of businesses.

Land disturbance: Offshore wind development would require onshore cable installation, substation construction or expansion, and possibly expansion of shore-based port facilities. Depending on siting, land disturbance could result in temporary, localized, variable disturbances of neighborhoods and businesses near cable routes and construction sites due to typical construction impacts such as increased noise, dust, traffic, and road disturbances. Potential short-term, variable, direct impacts on environmental justice communities could result from land disturbance, depending upon the particular location of onshore construction for each offshore wind project.

3.8.1.2. Conclusion

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impact on environmental justice populations. BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities will have continuing impacts on environmental justice populations through impacts on industries that provide job opportunities for low-income residents and construction-related air pollutant emissions and noise when these occur near environmental justice communities.

Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in overall minor adverse impacts, primarily through indirect, short-term impacts from cable emplacement, construction-phase noise and vessel traffic, and the long-term presence of offshore structures, which could affect marine-dependent businesses, resulting in job losses for low-income workers. Construction-related port activities could have direct impacts on environmental justice communities near ports through air emissions, traffic, or noise.

BOEM also anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in beneficial impacts through economic activity and job opportunities in marine trades and the offshore wind industry. Beneficial impacts are noted for completeness, but are not part of an environmental justice review under federal guidelines (CEQ 1997); therefore, are not assigned a level of significance.

3.8.2. Proposed Action and Action Alternatives

3.8.2.1. Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on environmental justice populations were described in Draft EIS Section-3.4.13, and additional information is included in Table 3.8-1. The Proposed Action would likely result in indirect **moderate** impacts on low-income workers in the commercial/for-hire fishing, marine recreation, and supporting industries. The Proposed Action would contribute to impacts through the IPFs named in Section 3.8.2. The most impactful IPFs would likely include vessel traffic during construction and the presence of offshore structures, due to the potential impacts of these IPFs on marine businesses (fishing and recreational) and subsistence fishing. In addition, new cable emplacement/maintenance would be one of the most impactful IPFs if the New Hampshire Avenue landfall site is selected.

The Draft EIS considered the extent to which environmental justice communities would be disproportionately impacted by direct impacts of the Proposed Action on resources such as air quality, water quality, employment and economics, recreation and tourism, commercial fishing, or navigation, due either to the location of these communities in relation to the Proposed Action or to their higher vulnerability to impacts. Although beneficial impacts are not considered in environmental justice evaluations, this section notes where beneficial impacts are anticipated, for completeness. The Draft EIS found that construction, operations, and decommissioning of the Proposed Action would have a **negligible** impact on environmental justice communities, with the following exceptions:

- Construction of the Proposed Action would result in an indirect, temporary, **moderate** impact on low-income workers in the commercial fishing industry. The impact would result from disruptions to fish populations from construction noise, restrictions on navigation near the offshore work areas, and increased vessel traffic near the ports and work areas.
- Selection of the New Hampshire Avenue landfall site could have a **major**, disproportionate impact on low-income residents in the commercial and for-hire recreational fishing industry near Lewis Bay due to the construction of the OECC cable through Lewis Bay, temporarily disrupting navigation in the heavily travelled area. The impact would be reduced to **moderate** by mitigation that avoids impacts on and does not prevent future dredging of the navigation channel.
- Operation of the Proposed Action would have a **moderate** impact on commercial and for-hire recreational fishing (Section 3.11), resulting in a **moderate** impact on environmental justice communities due to the vulnerability of low-income workers to economic impacts.

Changes to the design capacity of the proposed turbines (to use 57 14-MW WTGs rather than 100 8-MW WTGs) would not alter the potential impacts on environmental justice for the Proposed Action and all other action alternatives, because the maximum-case scenario involved the maximum number of WTGs (100) allowed in the PDE, which would have the maximum impact on vessel traffic for commercial and recreational fishing and boating and related industries that provide employment for low-income workers. Increasing the size of the proposed substation by 2.2 acres (less than 0.1 km^2), as described in Chapter 2, would not change the analysis of environmental justice impacts for the Proposed Action and all other action alternatives, because (as discussed in Section-3.12.2), the expanded substation area would be within a designated industrial area. In addition, the construction and operation of the expanded substation would not have meaningfully different effects on environmental justice communities, compared to those of the substation evaluated in the Draft EIS.

The cumulative impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are listed by IPF in Table 3.8-1 The most impactful IPFs would include temporary, higher levels of air emissions and noise at port facilities near environmental justice communities and the presence of offshore structures that would affect navigation and commercial fishing. Beneficial economic impacts would result from port utilization.

The cumulative impacts of the Proposed Action when combined with past, present and reasonably foreseeable activities would be similar to those described in Section 3.8.1, but may differ in intensity and extent. If the proposed Project is not approved, it is assumed that the energy demand that the Vineyard Wind 1 Project would have filled would likely be met by other projects in remaining areas of the Massachusetts, Rhode Island, and/or New York leases. Although the impacts from a substitute project may differ in location and time, depending on where and when offshore wind facilities are built out to meet the remaining demand, the nature of impacts and the total number of WTGs would be similar either with or without the Proposed Action, as described in Section 3.8.1. In other words, future offshore wind facilities capable of generating 9,404 MW would be built in the RI and MA Lease Areas, although, in the absence of the Proposed Action, none would be built before 2021. Therefore, the cumulative impacts related to WTGs would generally be equal to those described in Section 3.8.1.1.

Air emissions: Emissions at offshore locations would have regional impacts, with no disproportionate impacts on environmental justice communities. However, environmental justice communities near ports could experience disproportionate air quality impacts, depending upon the ports that are used, ambient air quality, and the increase in emissions at any given port. The Proposed Action's contributions to increased air emissions at the ports of Providence, Quonset-Davisville, New Bedford, and Vineyard Haven, near environmental justice communities, were not specifically evaluated in the Draft EIS. As stated in Section 3.1.2, overall air emissions impacts would be minor during Proposed Action construction, operations, and decommissioning, with the greatest quantity of emissions produced at the offshore WDA and by vehicles transiting from ports to the WDA. The Proposed Action would use the MCT at the Port of New Bedford as its primary port staging location for construction, which has other industrial and commercial sites with less intense uses, as well as major roads, separating residential neighborhoods from the MCT (Sasaki et al. 2016). Therefore, air emissions from the Proposed Action would have **negligible** impacts on environmental justice communities near the ports.

Net reductions in CO_2 emissions resulting from the Proposed Action would result in long-term benefits to communities (regardless of environmental justice status) by displacing emissions from fossil fuel-generated power plants (Section A.8.1 in Appendix A).

As noted in Section A.8.1 in Appendix A , other offshore wind projects using ports within the geographic analysis area for environmental justice populations would overlap with the Vineyard Wind 1 Project operations phase, and air quality impacts during the construction phase would be likely to vary from minor to moderate significance levels. The impacts at ports close to environmental justice communities cannot be evaluated because port usage has not been identified; however, most air emissions would occur at offshore locations rather than at the ports. Depending upon the specific ports selected to support construction, air emissions from the Proposed Action, in combination with the No Action Alternative, would have a direct, variable, temporary, and **negligible** to **minor** impact on environmental justice communities.

Light: As described in Section 310.2, nighttime aviation safety lighting on all of the Proposed Action's WTGs could be visible from coastal locations on Martha's Vineyard, Nantucket, and possible Cape Cod, depending on vegetation, topography, weather, and atmospheric conditions. Vineyard Wind has committed to voluntarily implement ADLS (as described in Draft EIS Section 3.4.1.3). An ADLS would activate the Proposed Action's WTG lighting when aircraft approach the Vineyard Wind 1 Project WTGs, which is expected to occur less than 0.1 percent of annual nighttime hours. As many as 17 of the Proposed Action's WTGs could be constructed within 15 miles (24 kilometers) of the shoreline, the area within which changes in visual conditions are more likely to result in impacts on recreation and tourism. As a result, the lighting would result in an indirect long-term, continuous, **negligible** impact on environmental justice communities, as a result of the negligible impact on the recreation/tourism economic sector that provides employment for low-income workers.

As stated in Section 3.10.2, aviation hazard lighting from 709 WTGs associated with the No Action Alternative and Proposed Action could potentially be visible from coastal locations. Section 3.10.2 concludes that the potential visibility of the additional aviation hazard lighting would result in a long-term, minor impact on recreation and tourism. This cumulative impact would be reduced to negligible if ADLS is used. As a result, the Proposed Action, in combination with the No Action Alternative would have continuous, long-term, **negligible** cumulative impacts on environmental justice communities, resulting from the anticipated minor impacts on the recreation and tourism economic sector. If implemented for projects other than the Proposed Action, ADLS would incrementally reduce the already **negligible** impacts on environmental justice communities associated with WTG lighting.

New cable emplacement/maintenance: Offshore cable emplacement for the Proposed Action would temporarily impact commercial/for-hire fishing businesses, marine recreation, and subsistence fishing during cable installation and infrequent maintenance. As noted in Sections 3.7.2, and 3.11.2, installation of the Proposed Action's cables would have short-term, localized, minor impacts on marine businesses (commercial fishing or recreation businesses). Installation and construction of the Proposed Action offshore components could therefore have a short-term, **minor** impact on low-income workers in marine businesses. As described in Draft EIS Sections 3.4.4 and 3.4.5, Lewis Bay is heavily travelled by commercial fishing, recreational, and ferry vessels. Construction of the offshore cable through Lewis Bay would temporarily disrupt these activities, require construction-related vessel traffic that could conflict with marine businesses, and lead to loss of revenue if commercial vessels are unable to enter or exit the bay as needed. The resulting economic impacts could disproportionately impact members of environmental justice communities whose low-income status makes them more vulnerable to changes in economic conditions. Therefore, the New Hampshire Avenue landfall site option for the Proposed Action would potentially have a localized, temporary, **major** impact on low-income residents in commercial fishing or marine recreation businesses.

Specific cable locations associated with future offshore wind projects have not been identified within the geographic analysis area for environmental justice populations with the exception of the Vineyard Wind 2 Project cable, which would use the same offshore cable corridor as the Proposed Action, but cable emplacement would impact over 3,398 acres (13.7 km^2). The Proposed Action, in combination with the No Action Alternative, would have a short-term, **minor** cumulative impact on environmental justice populations that rely on subsistence fishing or employment and income from marine businesses, except that the New Hampshire Avenue landfall site would have a localized, short-term, **major** impact, due to the potential effects on vessel traffic in Lewis Bay.

Onshore construction includes installation of the onshore cable, primarily within public road and utility ROWs, and substation construction within a designated industrial area. Air emissions from onshore construction of the Proposed Action would be temporary and variable, with **negligible** impacts on environmental justice communities. The Proposed Action's onshore construction activities are not anticipated to overlap in location and time with the onshore cable installation and substation construction of other offshore wind projects. If onshore cable installation or substation construction for the Proposed Action and another offshore wind project occurred at the same time and within or adjacent to environmental justice communities, the resulting noise, dust, road disturbance and air emissions from the Proposed Action in combination with the No Action Alternative could have direct, temporary, variable, **negligible** to **minor** impacts on the environmental justice communities.

Noise: The Draft EIS did not consider the impact of offshore noise on environmental justice communities; however, noise is an IPF that could affect fish and marine mammals, with resulting impacts on employment and income from marine businesses. As noted in Section 3.7.2, the Proposed Action's contribution to noise from site assessment G&G survey activities, operations and maintenance, pile driving, trenching, and vessels is anticipated to have direct and indirect, short-term, intermittent, **negligible** impacts on visitors, workers, and residents. Therefore, the Proposed Action's construction noise would have indirect, short-term, **negligible** impacts on the members of environmental justice populations who rely on subsistence fishing or employment and income from marine businesses.

The noise from multiple offshore survey and project construction activities (primarily G&G survey activity and pile driving) during offshore wind development would have short-term impacts on fish and marine mammals, as discussed in Sections 3.4, 3.5, and 3.11. The increased impacts would have indirect cumulative impacts on the fishing and sightseeing businesses that rely on these species, resulting in impacts on employment, income, and subsistence fishing. Accordingly, offshore noise generated by construction of the Proposed Action, in combination with the No Action Alternative, would have indirect impacts on marine businesses, resulting in indirect, short-term, **negligible** to **minor** impacts on low-income employees of marine-dependent businesses.

Noise generated by the Proposed Action's staging operations at ports would potentially have direct, disproportionately high impacts on environmental justice communities if the port is located near such communities. Although no port expansion is proposed in connection with the Proposed Action, the Proposed Action would primarily use the Port of New Bedford and may also use the ports of Providence and Quonset-Davisville, all located near environmental justice communities. The Port of New Bedford has other industrial and commercial sites with less intense uses, as well as major roads, separating residential neighborhoods from the MCT (Sasaki et al. 2016); therefore, noise from the Proposed Action would have direct, short-term, variable, negligible impacts on environmental justice communities near the ports. The noise impacts from increased port utilization would increase if a port is used for more than one offshore wind project. Depending upon the specific ports selected to support construction, noise from the Proposed Action, in combination with the No Action Alternative, would have a direct, variable, temporary, negligible to minor impact on environmental justice communities.

Noise from onshore construction of the Proposed Action would be temporary and variable, with negligible impacts on environmental justice communities. The Proposed Action's onshore construction activities are not anticipated to overlap in location with other offshore wind projects; therefore, would not produce cumulative noise impacts on environmental justice communities. If onshore construction did overlap with other offshore wind projects adjacent to the environmental justice communities identified for the Proposed Action, the Proposed Action in combination with the No Action Alternative could have direct, temporary, variable, negligible to minor impacts on the environmental justice communities near the construction.

Port utilization: Expansion: No port expansion is proposed in connection with the Proposed Action. The Proposed Action's contributions to increased utilization of the ports of New Bedford, Providence, Quonset-Davisville, and Vineyard Haven may have beneficial impacts on environmental justice communities due to increased employment opportunities and business activity. Impacts on environmental justice communities from increased port utilization could result from temporary air emissions and noise during construction.

The Proposed Action, in combination with the No Action Alternative, would also have beneficial impacts on environmental justice communities, due to increased employment opportunities and business activity. (Beneficial impacts are noted for completeness, but are not part of an environmental justice review under federal guidelines [CEQ 1997]. Therefore, they are not assigned a level of significance.)

Presence of structures: The Proposed Action's establishment of offshore structures, including up to 100 WTGs, 2 ESPs, and hard cover for cables, would result in both adverse and beneficial impacts on marine businesses (i.e., commercial and for-hire recreational fishing businesses, offshore recreational businesses, and related businesses) and subsistence fishing. Beneficial impacts would be generated by the reef effect of offshore structures, providing additional opportunity for subsistence fishing and for-hire recreational fishing businesses. Impacts would result from navigational complexity within the WDA, disturbance of customary routes and fishing locations, and the presence of scour protection and cable hard cover, leading to possible equipment loss and limiting certain commercial fishing methods. Overall, the offshore structures would have minor to moderate impacts on marine businesses (Sections 3.7.2 and 3.11.2), resulting in direct and indirect, long-term, and continuous, minor impacts on environmental justice populations due to the impact on low-income workers in marine industries and low-income residents who rely on subsistence fishing.

The Proposed Action in combination with other offshore wind energy projects would result in a greater number of offshore structures affecting larger offshore areas. Offshore structures for the Proposed Action, in combination with the No Action Alternative, would have direct and indirect, long-term, continuous, minor impacts on environmental justice populations due to the impact on low-income workers in marine industries and low-income residents who rely on subsistence fishing.

As described in Section 3.10.2, portions of all of the Proposed Action's WTGs could potentially be visible from coastal locations on Martha's Vineyard, Nantucket, and mainland Cape Cod, depending upon vegetation, topography, and atmospheric conditions. Under the 14 MW scenario, nearly all coastal public viewpoints would be more than 15 miles (24.1 kilometers) from the closest WTGs (although additional WTGs could be within 15 miles of other coastal areas not evaluated as distinct viewpoints). Based upon the number of WTGs less than 15 miles from coastal viewing points and available research (Section 3.10), the impact of visible WTGs on recreation and tourism is anticipated to be minor, and the impact is unlikely to meaningfully affect the recreation and tourism industry as a whole. Views of WTGs associated with the Proposed Action are therefore anticipated to have a negligible impact on environmental justice populations based upon the minimal anticipated impact on low-income employees of the recreation and tourism economic sector.

Cumulatively, portions of 709 WTGs could potentially be visible from coastal and elevated locations on Martha's Vineyard, Nantucket, and coastal Cape Cod. The views could affect recreation and tourism at a limited number of locations (Section 3.10.2); however, Section 3.7 anticipates that the Proposed Action, in combination with other offshore wind projects, would have negligible impacts on the economic activity generated by recreation and tourism in the geographic analysis area. As a result, the Proposed Action, in combination with the No Action Alternative, would have continuous, long-term, negligible cumulative impacts on environmental justice communities based upon the potential impact on low-income employees of the recreation and tourism economic sector.

Traffic, Vessels: The Proposed Action would generate vessel traffic within and near the Port of New Bedford and Vineyard Haven Harbor during construction and operations, and may also use the ports of Providence and Quonset-Davisville. In addition, Proposed Action construction would add to the vessel traffic in Lewis Bay if the New Hampshire Avenue OECC cable landfall site location is selected. Draft EIS Section 3.4.2.3 concludes that vessel traffic associated with construction of the Proposed Action would have a short-term, moderate impact on commercial fishing and for-hire recreational fishing, due to increased vessel traffic near ports, and potential displacement from berths and docks. Based on the potential impacts on commercial and for-hire recreational fishing, the construction and decommissioning of the Proposed Action would have a short-term, variable, moderate impact on environmental justice communities near the ports, specifically low-income residents involved in the commercial fishing industry or subsistence fishing. Vessel traffic would be modest during operations and would have a long-term, negligible impact on environmental justice communities.

Vessel traffic would increase if multiple offshore wind projects use the same ports during overlapping construction periods. The impact on environmental justice populations may increase, but is still anticipated to be of a moderate level. Therefore, the Proposed Action, in combination with the No Action Alternative, would have short-term, moderate impacts on environmental justice populations during construction and decommissioning, due to the potential impacts on low-income employees of the commercial/for-hire fishing industry. The vessel traffic from the Proposed Action during operation, in combination with the No Action Alternative, would have negligible impacts on environmental justice communities.

Vessel traffic from the Proposed Action, and from the Proposed Action in combination with the No Action Alternative, would also have beneficial impacts on environmental justice communities through the provision of jobs and business activity.

Land disturbance: As shown in the Draft EIS, on Figure F.2-3 in Appendix F, the Proposed Action substation is in an area that meets the criteria for both low-income and minority status. A majority of the route for the Covell's Beach landfall site would pass through or adjacent to communities that meet low-income and/or minority environmental justice criteria. A small segment of the route for the New Hampshire Avenue landfall site would pass adjacent to a low-income community. Construction of the OECR would temporarily disturb neighboring land uses through construction noise, vibration and dust, and delays in travel along the impacted roads. Environmental justice and non-environmental justice communities would equally experience these impacts, and access to neighborhoods would be maintained. Accordingly, land disturbance from the onshore construction of Proposed Action components, including the cable route resulting from either the Covell's Beach or New Hampshire Avenue landfall locations, would have direct, temporary, negligible impacts on environmental justice communities.

The Proposed Action's onshore land disturbance activities are not anticipated to overlap in location with other offshore wind projects; therefore, would not produce cumulative impacts. If land disturbance did overlap with other offshore wind projects adjacent to the environmental justice communities identified for the Proposed Action, the Proposed Action in combination with the No Action Alternative could have direct, temporary, variable, negligible to minor impacts on the environmental justice communities.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from negligible to major. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with past, present, reasonably foreseeable activities would result in minor impacts on environmental justice populations in the analysis area. The main drivers for the impact ratings are the long-term, minor impacts associated with the presence of offshore structures, as discussed in Section 3.8.2, which affect marine-dependent businesses (commercial fishing, for-hire recreational fishing, boat tours and other marine recreational businesses) that may hire low-income workers. The Proposed Action would contribute to the overall impact rating primarily through the same IPFs. The overall impact rating is also supported by anticipated minor impacts from air emissions and cable emplacement, and moderate impacts from vessel traffic, which would be short term and variable. The major impact from cable emplacement could occur only if the New Hampshire landfall site is used for the Proposed Action and would be temporary and localized.

3.8.2.2. Cumulative Impacts of Alternatives B, C, D1, D2 and E

The direct and indirect impacts of Alternatives B, C, D1, D2, and E on environmental justice populations are described in the Draft EIS Sections 3.4.2.4 through 3.4.2.7. These impacts are summarized below:

- The difference between Alternative B and the Proposed Action is the selection of Covell's Beach as the landfall site and the resultant avoidance of impacts on businesses and economic activity in and near Lewis Bay. By avoiding obstruction of the Lewis Bay navigation channel and congestion within the Bay, this alternative would avoid potentially major impacts on local employment in the commercial fishing and marine recreational industries, thus avoiding impacts on low-income employees of these industries in the environmental justice communities around Lewis Bay. In other respects, the direct and indirect impacts of Alternative B on environmental justice populations would be the same as those of the Proposed Action.
- Alternative C would locate six WTGs away from the northern portion of the WDA, thus providing more unobstructed space for navigation in the northern WDA and reducing visual impacts on land-based recreation areas. As noted in Sections 3.10 and 3.11, the overall level of impact on recreation and tourism and commercial fishing (respectively), and the related employment opportunities, would not change; therefore, the impacts of Alternative C on environmental justice populations would be the same as those of the Proposed Action.
- Alternatives D1 and D2 would result in different WTG configurations, each of which would marginally increase navigation flexibility, but would not change the overall environmental justice impacts of the proposed Project. As noted in Section 3.13, Alternatives D1 and D2 would have both direct and indirect beneficial impacts (increased spacing between WTGs, improved maritime navigation) and adverse impacts (increased WDA size), depending on fishery and activity, with no change to the overall impact level. Therefore, the impacts of these alternatives on low-income workers in commercial fishing and supporting industries would be similar to those of the Proposed Action.
- Alternative E would include up to 84 WTGs using a combination of 9- to 10-MW WTGs, compared to 100, 8-MW WTGs for the Proposed Action, with potential increases in the spacing of WTGs and improved access to fishing locations. No change in the overall impact level on commercial and for-hire recreational fishing is anticipated (Section 3.11). Other environmental justice impacts of Alternative E would be the same as the Proposed Action.

Accordingly, the direct and indirect impacts resulting from individual IPFs associated with Alternatives B, C, D1, D2, and E on environmental justice communities would be the same as those of the Proposed Action: negligible to moderate impacts, due to the IPFs discussed above, along with beneficial impacts due to new hiring and economic activity.

The cumulative impacts resulting from individual IPFs associated with Alternatives B, C, D1, D2 and E, when combined with past, present, and reasonably foreseeable projects, would be similar to those of the Proposed Action: negligible to moderate, because the majority of the cumulative impacts of any alternative come from other offshore wind projects, and the direct and indirect impacts of each alternative would be very similar to those of the Proposed Action. If another offshore wind project selected a cable landfall location similar to the New Hampshire Avenue location that required installation through Lewis Bay, **major** cumulative impacts could result.

The overall cumulative impacts of each alternative on environmental justice populations within the geographic analysis area, when combined with past, present, and reasonably foreseeable activities, would be **minor**. The impact rating is primarily driven by potential impacts on low-income workers in marine industries from the long-term presence of offshore structures and short-term noise, cable emplacement, and vessel traffic.

3.8.2.3. Direct, Indirect, and Cumulative Impacts of Alternative F

Alternative F analyzes a vessel transit lane through the WDA within which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. Under this alternative, BOEM is analyzing a 2- and 4-nautical-mile northwest/southeast vessel transit lane through the WDA combined with any action alternative; however, this analysis focuses on the combination of Alternative F with either the Proposed Action or Alternative D2 layout. The northern transit lane within the WDA could result in the relocation of 16 to 34 WTG placements and a 12 to 61 percent increase in the size of the WDA and extent of inter-array cables (depending on whether the Proposed Action or Alternative D2 layout is used).

The direct and indirect impacts of Alternative F on environmental justice populations would be less than the Proposed Action, based upon the conclusion in Section 3.7.2 that the revised layout would reduce impacts on marine businesses from IPFs related to the presence of offshore structures—a change that would also reduce impacts on the low-income workers employed in these industries. By reducing impacts on these businesses, Alternative F would have a smaller incremental impact on environmental justice populations, although those impacts resulting from individual IPFs would remain **negligible** to **moderate**. Based on BOEM's analysis this would be true regardless of the width of the transit lane, and regardless of the implementation of Alternative F with the Proposed Action layout or any other action alternative layout.

The cumulative impacts resulting from individual IPFs associated with Alternative F when combined with past, present, and reasonably foreseeable activities, would be very similar to those of the Proposed Action, with **negligible** to **moderate** impacts on environmental justice populations along with beneficial impacts due to new hiring and economic activity. The majority of the cumulative impacts of any alternative come from other offshore wind projects, and the direct and indirect impacts of this alternative would be very similar to those of the Proposed Action. The overall cumulative impacts of Alternative F on environmental justice populations within the geographic analysis area, when combined with past, present, and reasonably foreseeable activities, would be **minor**. The impact rating is primarily driven by impacts from the long-term presence of offshore structures and short-term air emissions, cable emplacement, and vessel traffic.

BOEM has qualitatively evaluated the cumulative impacts of implementing all six RODA-recommended transit lanes, including the northern transit lane described for Alternative F, as well as five other transit lanes through the RI and MA Lease Areas. To the extent additional transit lanes are implemented in the future outside the WDA as part of RODA's suggestion, the WTGs for future offshore wind projects may need to be located farther from shore, similar to the proposed Project under Alternative F. As a result, establishment of these additional transit lanes could require longer vessel trips for all phases of future projects and longer timeframes for cable installation. Collectively, these effects would result in greater impacts on environmental justice populations overall than if Alternative F were not implemented, due to increased impact on marine businesses (as discussed in Section 3.7.2.3) that employ low-income residents in the analysis area.

3.8.2.4. Comparison of Alternatives

The Proposed Action would affect environmental justice through the IPFs discussed in Section 3.8.2.1. The Proposed Action would result in indirect, localized, short term to long-term, **negligible** to **minor** impacts on geographic areas with higher proportions of low-income and minority populations, and would potentially have **minor** to **moderate** impacts on low-income members of environmental justice communities who work in the commercial fishing, for-hire recreational fishing, and marine recreation industries due to the impact on subsistence fishing, commercial fishing, and marine recreation.

As discussed in Draft EIS Section 3.4.2.9, the alternatives are very similar in terms of the impacts on environmental justice communities and populations, except that Alternative B would have incrementally smaller impacts on environmental justice communities due to avoidance of impacts in Lewis Bay, and Alternative F would result in a n incrementally smaller impact on commercial fishing and marine recreation businesses due to reduced navigational impacts related to offshore structures. The differences in Alternatives B and F would not change the overall impact magnitudes, compared to those of the Proposed Action. As a result, all alternatives resulting from individual IPFs would have **negligible** to **moderate** impacts on environmental justice populations. Net reductions in emissions resulting from offshore wind development would result in long-term, regional air quality benefits (regardless of environmental justice status) by displacing emissions from fossil fuel-generated power plants.

The IPFs of the Proposed Action, when combined with past, present, and reasonably foreseeable activities, could result in cumulative impacts whenever activities occur within the geographic analysis area or overlap in time. Cumulative impacts under the Proposed Action or any action alternative would likely be very similar because the majority of the cumulative impacts of any alternative come from other future offshore wind development, which does not change between alternatives, and the differences in direct and indirect impacts between action alternatives would not result in different direct and indirect impact magnitudes. As a result, the cumulative impacts resulting from individual IPFs associated with any action alternative when combined with past, present, and reasonably foreseeable future activities would have in indirect, localized to regional, short term to long-term, negligible to moderate impacts on environmental justice populations.

In conclusion, the overall cumulative impacts on environmental justice from any action alternative, when combined with past, present, and reasonably foreseeable activities would be minor. The impact rating is primarily driven by impacts from the long-term presence of offshore structures and short-term air emissions, cable emplacement, and vessel traffic.

3.9. Cultural Resources

3.9.1. No Action Alternative Impacts

Table 3.9-1 contains a detailed summary of the baseline conditions and the impacts of ongoing and future offshore activities other than offshore wind on cultural resources, based on the IPFs assessed. This information comes primarily from the Draft EIS, supplemented by information developed in responding to comments on the Draft EIS, the Section 106 review, and additional resources. The impact analysis is limited to impacts within the geographic analysis area for cultural resources, as described in Table A-1 and shown on Figure A.7-8 in Appendix A. Specifically, this includes areas of terrestrial and offshore areas potentially affected by land or bottom-disturbing activities, as well as the area of intervisibility where structures from both the Proposed Action and future offshore wind projects would be visible simultaneously.

The No Action Alternative assumes the full build out of all reasonably foreseeable wind projects. BOEM assumes that each of the reasonably foreseeable wind projects will be subject to NEPA and National Historic Preservation Act (NHPA) reviews and, as a result, will require the identification of cultural resources within their NEPA geographic scopes and NHPA areas of potential effect (APE). The results of these project-specific studies to identify cultural resources are not yet available. As a result, 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 standing structures, terrestrial archaeological sites, ship and aircraft wrecks, debris fields, and paleolandform features) are present within the geographic scopes of the reasonably foreseeable wind projects, and will be subject to the same IPFs as the Proposed Action. The following discussion assesses the potential impacts on these types of cultural resources from proposed wind facility developments, excluding the Proposed Action. BOEM assumes that if project-specific cultural resource investigations identify historic properties within a project's NHPA APE and it is determined that the project would adversely affect said historic properties, BOEM will require the project to develop treatment plans to avoid, minimize, and/or mitigate effects in order to comply with the NHPA.

Onshore cultural resource investigations in the northeastern United States have identified a wide variety of archaeological resources, historic structures, and traditional cultural properties (TCPs) that could be adversely affected by development projects, including future offshore wind. Previously identified archaeological resources include terrestrial pre-contact period Native American sites and colonial period through 20th century European-American sites. Terrestrial archaeological studies along the Proposed Action onshore cable routes and substation location identified a number of pre-contact period Native American and post-contact period European-American archaeological sites. Historic standing structures found across the northeastern United States include a wide variety of residential, commercial, and industrial buildings, structures, and infrastructure that date from the 16th through 20th centuries. Potential TCPs in the northeastern United States include a variety of locations associated with the cultural practices, traditions, beliefs, lifeways, arts, crafts, and/or social institutions of Native American, European-American, and other living communities across the region.

Offshore cultural resources in the northeastern United States 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 that date to before the end of the last glacial maximum. These landscapes may contain the remains of 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 35 paleolandform features with the potential to contain Native American archaeological resources within the Proposed Action WDA and OECC; all of the proposed offshore wind lease areas are in areas with high probability for containing these submerged paleolandform features (TRC 2012). In addition to their archaeological potential, Native American Tribes in the region consider the remains of the submerged paleolandscape to be TCP resources representing places where their ancestors lived. Historic period European-American marine cultural resources consist of shipwrecks, downed aircraft, and related debris fields dating to the 16th through 20th centuries. Marine geophysical remote sensing studies performed for the Proposed Action identified two shipwrecks and five debris field cultural resources within the WDA and OECC. Based on known historic and modern maritime activity in the region and the location of known historic shipwrecks, all of the proposed offshore wind lease areas are in areas with a high probability for containing shipwrecks, downed aircraft, and related debris fields.

Under the No Action Alternative, the proposed Project would not be built and hence would have no impact on cultural resources. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. If the Vineyard Wind 1 Project is not approved, then impacts from the proposed Project would not occur as proposed. However, the state demand that the Vineyard Wind 1 Project would have filled, if approved, could likely be met by other projects in the geographic analysis area for cultural resources. Therefore, the impacts on cultural resources would be similar, but the exact impact 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 and considers the assumptions included in this SEIS Section 1.2 and Appendix A. Detailed analysis of impacts associated with future offshore wind development is provided in Section 3.9.1.1 and summarized in Table 3.9-1. Cumulative impacts of the Proposed Action and action alternatives are analyzed in Section 3.9.2.

3.9.1.1. Future Offshore Wind Activities (without Proposed Action)

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

Accidental releases: Accidental release of hazardous materials and trash/debris, if any, may pose a long-term, infrequent risk to cultural resources. The majority of impacts associated with accidental releases would be indirect, due to cleanup activities that require the removal of contaminated soils. In the expanded cumulative scenario, there would be a low risk of a leak of fuel, fluids, or hazmat from any of the approximately 775 WTGs and 20 ESPs. Each WTG would store approximately 5,049 gallons (19,113 liters) of such fluids, while each ESP would store approximately 129,301 gallons (489,458 liters). In total, approximately 5.3 million gallons (20 million liters) would be stored within the geographic analysis area for cultural resources. By comparison, the smallest tanker vessel operating in these waters (a general-purpose tanker) has a capacity of between 3.2 and 8 million gallons (12.1 million to 30.3 million liters). As described in Draft EIS Section 3.4.7.1, tankers are relatively common in these waters; therefore, the total storage capacity within the geographic analysis area is considerably less than the volumes of hazardous liquids being transported by ongoing activities (U.S. Energy Information Administration 2014). The number of accidental releases from the No Action Alternative, the volume of released material, and the associated need for cleanup activities would be limited due to the low probability of occurrence, the low volumes of material released in individual incidents, the low persistence time, standard BMPs to prevent releases, and the localized nature of such events. As such, the majority of individual accidental releases from future offshore wind development would not be expected to result in measureable impacts on cultural resources.

Although the majority of anticipated accidental releases would be small, resulting in small-scale impacts on cultural resources, a single, large-scale accidental release such as an oil spill, could have significant impacts on marine and coastal cultural resources. A large-scale release would require extensive cleanup activities to remove contaminated materials resulting in damage to or the complete removal of coastal and marine cultural resources during the removal of contaminated terrestrial soil or marine sediment; environmental impacts could result in temporary or permanent impacts on the setting of coastal historic standing structures; and nearshore shipwreck or debris field resources could be damaged or removed 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, accelerating their decomposition and/or covering them and making them inaccessible/unrecognizable to researchers, resulting in a significant loss of historic information. As a result, although considered unlikely, a large-scale accidental release and associated cleanup could result in permanent, geographically extensive, and large-scale impacts on cultural resources.

Anchoring, gear utilization, and dredging: Anchoring, gear utilization, and dredging activities associated with ongoing commercial and recreational activities and the development of future offshore wind projects have the potential to cause permanent, adverse impacts on marine cultural resources. Anchoring, gear utilization, and dredging activities will increase during the construction, maintenance, and eventual decommissioning of future offshore wind energy facilities. The expanded cumulative scenario could result in up to 126 acres (0.5 km^2) of seafloor in the geographic analysis area for cultural resources affected by anchoring that could potentially impact cultural resources. The placement and relocation of anchors and other seafloor gear such as wire ropes, cables, and anchor chains that affect or sweep the seafloor could potentially disturb shipwreck and debris field resources on or just below the seafloor surface. Dredging activities could similarly affect marine cultural resources. 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.

The scale of impacts on shipwreck and debris field cultural resources would depend on the number of wreck and debris field sites within the proposed wind project development areas. NOAA's Office of Coast Survey's Automated Wreck and Obstruction Information System (AWOIS) and Electronic Navigational Chart (ENC) databases contain records for more than 30 recorded or known shipwreck sites within the lease blocks for the future offshore wind projects within the geographic analysis area of this study (NOAA 2019c). Anchoring, gear utilization, and dredging could potentially impact each of these sites, as well as unrecorded shipwreck sites in these areas. Dredging and gear utilization associated with the development of future offshore wind projects could impact all 30 of these resources and undiscovered shipwreck sites, resulting in large scale, geographically extensive, and permanent impacts on these cultural resources.

The potential for impacts would be mitigated, however, by existing federal and state requirements to identify and avoid marine cultural resources. Specifically, NHPA Section 106 requires offshore wind developers to conduct geophysical remote sensing surveys of proposed development areas to identify cultural resources and implement plans to avoid, minimize, and/or mitigate impacts on these resources. As a result, impacts on marine cultural resources from anchoring, gear utilization, and dredging are considered unlikely, and would only affect a small number of individual marine cultural resources if they were to occur, resulting in long-term, localized, adverse impacts. The scale of any impacts on individual resources (the proportion of the resource damaged or removed) would vary on a case-by-case basis.

Light: Development of future offshore wind industry would increase the amount of offshore anthropogenic light from vessels, area lighting during the construction and decommissioning of projects (to the degree that construction occurs at night), and the use of hazard/warning lighting on WTGs and ESPs during operation. Up to 795 foundations (775 WTGs and 20 ESPs) would be added within the geographic analysis area for cultural resources, assuming WTGs with a maximum blade tip height of 853 feet (260 meters) above mean sea level (AMSL).

Construction and decommissioning lighting would be most noticeable if construction activities occur at night. As shown in Table A-4 in Appendix A, up to 12 different lease areas could be constructed from 2021 through 2030 (with up to four projects simultaneously under construction in 2022 and 2023). Some of these future 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 ESP sites, rather than the entire RI and MA Lease Areas. Hazard lighting systems would be in use for the entire operations phase of each future offshore wind project, resulting in long duration 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.

The impacts of construction and operations lighting would be limited to cultural resources on the southern shores of Martha's Vineyard, Nantucket, and possibly portions of Cape Cod, for which a nighttime sky is a contributing element to historical integrity. This excludes resources that are closed to stakeholders at night, such as historic buildings, lighthouses, and battlefields and resources that generate their own nighttime light, such as historic districts. The intensity of lighting impacts would be limited by the distance between resources and the nearest lighting sources, as the majority of the proposed WTGs are located over 15 miles (24.1 kilometers) from the nearest shoreline (Draft EIS Section 3.4.4). The intensity of lighting impacts would be further reduced by atmospheric and environmental conditions such as clouds, fog, and waves that could partially or completely obscure or diffuse sources of light. As a result, nighttime construction and decommissioning lighting would have temporary, intermittent, and localized adverse impacts on a limited number of cultural resources. Operational lighting would have longer-term, continuous, and localized adverse impacts on a limited number of cultural resources.

Lighting impacts would be reduced if ADLS is used. ADLS would be activated only when an aircraft approaches (detailed explanation in Section 3.7). For the Proposed Action, this is estimated to occur during less than 0.1 percent of total annual nighttime hours (Draft EIS Section 3.4.4). The use of ADLS lighting on future offshore wind projects other than the Proposed Action would likely result in similar limits on the frequency of WTG aviation warning lighting use. This technology, if used, would reduce the already low-level impacts of lighting on cultural resources.

Port utilization: Expansion: Increases in global shipping traffic and expected increases in port activity associated with the development of future offshore wind projects would likely require port modifications and expansions at ports along the U.S. East Coast. The Massachusetts Clean Energy Center identified 18 waterfront sites in Massachusetts that could be available and suitable for use by the offshore wind industry (MassCEC 2017a, b). Orsted has committed to improvements to Rhode Island ports in support of the Revolution Wind Project (Kuffner 2018). These port modification and expansion projects could affect historic structures and/or archaeological sites within or near port facilities. Future channel deepening by dredging that may be required to accommodate larger vessels required to carry WTG components and/or increased vessel traffic associated with future 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, and/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.

Presence of structures: The development of future offshore wind projects would introduce new, modern, and intrusive visual elements to the viewsheds of cultural resources along the southern coasts of Rhode Island and Massachusetts, including Martha's Vineyard, Nantucket, and adjacent islands. In the expanded cumulative scenario, up to 795 foundations (775 WTGs and 20 ESPs) would be added within the geographic analysis area for cultural resources, assuming WTGs with a maximum blade tip height of 853 feet (260 meters) AMSL. Future offshore wind projects could adversely impact views from cultural resources. The magnitude of impacts from the presence of structures would be greatest for cultural resources for which a maritime view, free of modern visual elements, is an integral part of their historic integrity and contributes to their eligibility for listing on the National Register of Historic Places (NRHP).

Impacts on cultural resources from the presence of structures would be limited to those cultural resources from which future offshore wind projects would be visible, which would typically be limited to historic standing structures relatively close to shorelines and on elevated landforms near the coast for which ocean viewsheds free of modern elements are a contributing element to their listing on the NRHP. Due to the distance between the reasonably foreseeable wind development and the nearest cultural resources, in most instances exceeding 15 miles (24.1 kilometers), WTGs within 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. Additional mitigations, such as the use of non-reflective off-white and light grey paint on offshore structures, could reduce the visibility of offshore structures and further reduce the magnitude of impacts on cultural resources.

New cable emplacement/maintenance: Construction of future offshore wind infrastructure would have permanent, geographically extensive, adverse impacts on cultural resources. Future offshore wind projects would result in the construction of 795 foundations for WTGs and ESPs and 3,400 acres (13.7 km^2) of seabed disturbance from installation of inter-array and offshore export cables. Given the locations of RI and MA Lease Areas and the COPs or other announced plans for offshore export cable routes, the only future offshore wind activities (other than the Proposed Action) that may reasonably be expected to lay cable in the geographic analysis area are Vineyard Wind 2 (OCS-A 0501 [southern portion]), Mayflower Wind (OCS-A 0521), possibly a development by Equinor Wind US (OCS-A 0520), and possibly Bay State Wind (OCS-A 0500). Of these, only Vineyard Wind 2 and Mayflower Wind have announced plans for cable routes in the geographic analysis area for cultural resources. Vineyard Wind 2 would lay cable within the same OECC as the Proposed Action, and Mayflower Wind would lay cable somewhere between Martha's Vineyard and Muskeget Island, through Nantucket Sound, making landfall somewhere on Cape Cod. Because precise cable corridors are not known for any specific project other than Vineyard Wind 2, the potential impacts of future offshore wind activities (other than the Proposed Action) on cultural resources are not reasonably quantifiable. The 2012 BOEM study and the Proposed Action studies (COP Volume II-C, Epsilon 2019b; TRC 2012; Vineyard Wind 2019) suggest that the WDAs and OECCs of the future offshore wind projects would likely contain a number of shipwrecks, downed aircraft, related debris fields, and paleolandform features which could be impacted by offshore construction activities.

Shipwrecks, downed aircraft, and their debris fields are considered significant and highly sensitive cultural resources. As previously discussed, the NOAA AWOIS and ENC databases contain records of over 30 shipwrecks within the WDA lease blocks for the wind projects in the geographic analysis area of this study (NOAA 2019c). All 30 of these shipwrecks and any undiscovered wreck sites in these areas could be permanently impacted by offshore construction activities. As part of compliance with the NHPA, BOEM will require future offshore wind project applicants to conduct extensive geophysical surveys of WDA and OECC areas to identify shipwreck and debris field resources. BOEM typically requires projects to avoid these resources through the creation of avoidance buffer zones around identified shipwrecks and/or remote sensing anomalies that could represent shipwreck resources. Due to these federal requirements, the adverse impacts of offshore construction on shipwreck and debris field resources would be infrequent and isolated.

Formerly sub-aerially exposed and now submerged paleolandscapes that date to a time of Native American inhabitation of North America prior to the last Ice Age are considered potentially significant resources due to their potential to contain archaeological sites, as well as their significance to regional Native American Tribes. Regional Native American tribes may consider extant paleolandform features to be part of a larger paleolandscape occupied by their ancestors. As a result the paleolandform features are considered part of a larger paleolandscape TCP due to their association with the cultural practices, traditions, and beliefs of Native American tribes. If present within a project area, the number, extent, and dispersed character of paleolandform features makes avoidance impossible in many situations, and makes the identification of formerly terrestrial archaeological sites within these paleolandform features logistically challenging and prohibitively expensive. As a result, offshore construction would result in geographically widespread and permanent adverse impacts on these resources. For those paleolandform features that are contributing elements to a National Register-eligible TCP, but which cannot be avoided, creative methods and concepts for mitigations are being considered under the Section 106 review process, including studies to document the nature of the paleoenvironment during the time these now submerged landscapes were occupied and provide Native American tribes with the opportunity to include their history of the paleolandscape in these studies.

Land disturbance: The construction of onshore components associated with future offshore wind projects, such as electrical export cables and onshore substations, could result in adverse impacts on known and undiscovered cultural resources. Ground-disturbing construction activities could affect undiscovered archaeological sites, while construction of aboveground infrastructure could affect known historic structures due to the introduction of intrusive, modern, visual elements. Underground and aboveground components could also adversely affect TCPs, if present. The number of cultural resources and/or historic properties impacted, the scale and extent of impacts, and the severity of impacts would depend on the location of specific project components relative to recorded and undiscovered cultural resources. State and federal requirements to identify cultural resources, assess project impacts, and develop treatment plans to avoid, minimize, and/or mitigate adverse impacts would limit the extent, scale, and magnitude of impacts on individual cultural resources; as a result, adverse impacts from this IPF would likely be long-term and localized.

Climate change: IPFs related to climate change, including sea level rise, ocean acidification, increased storm severity/frequency, and increased sedimentation and erosion, have the potential to result in long-term/permanent impacts on cultural resources. Sea level rise will lead to the inundation of terrestrial archaeological sites and historic standing structures. Increased storm severity/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 coastal historic standing as erosion undermines structures. Ocean acidification could accelerate the rate of decomposition/corrosion of marine archaeological resources, as well as impacts on traditional uses of the Nantucket Sound and Chappaquiddick Island TCPs. The incremental 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.

3.9.1.2. Conclusions

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impact on cultural resources. BOEM expects cultural resources to continue to be affected by regional commercial, industrial, and recreational activities including future offshore wind projects.

Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in overall moderate adverse impacts, due primarily to physical disturbance from onshore and offshore construction, as well as changes in views. The impacts would be geographically limited to marine and terrestrial archaeological resources within onshore and offshore construction areas and historic standing structures with views of offshore and onshore wind components, for which an uninterrupted sea view, free of modern visual elements, is a contributing element to NRHP eligibility. The duration of impacts would range from temporary to permanent while the extent and frequency of impacts is largely dependent on the unique characteristics of individual cultural resources. BOEM anticipates that implementation of existing state and federal cultural resource laws and regulations would reduce the magnitude of impacts on cultural resources due to requirements to avoid, minimize, and/or mitigate Project-specific impacts on cultural resources.

3.9.2. Proposed Action and Action Alternatives

3.9.2.1. Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on cultural resources were described in Draft EIS Section 3.4.3.3, and additional information is included in Table 3.9-1. Changes to the design capacity of the WTGs compared to the WTGs evaluated in the Draft EIS would alter the maximum potential impacts on cultural resources for the Proposed Action and all other action alternatives. If Vineyard Wind were to install 57 14-MW WTGs instead of the potential 100 8-MW WTGs initially evaluated, the overall height of the 14-MW WTGs (a hub height of 473 feet AMSL and a maximum blade tip height of 837 feet AMSL) would increase the number and portion of WTGs visible from affected resources. Because of the increased visibility of the 14-MW WTGs, this section evaluates the cumulative impacts on cultural resources of the Proposed Action with the 14-MW WTG option. Changes to the proposed onshore substation site could change the assessed impacts of the Proposed Action and all other action alternatives on terrestrial cultural resources. The Draft EIS assessed a 6.4-acre (25,900-m^2) substation site and Vineyard Wind has subsequently expanded the site by approximately 2.2 acres (8,903 m^2) along the west side. The majority of the 2.2-acre (8,903-m^2) area expansion has been previously disturbed, but 0.64 acre (2,428 m^2) would need to be investigated for terrestrial cultural resources. Vineyard Wind has completed terrestrial archaeological investigations aligned with Massachusetts's state requirements in all portions of the terrestrial archaeological APE, except for the 0.64-acre (2,428-m^2) area associated with this substation expansion. This survey would be completed after the COP is approved and in accordance with the Section 106 Memorandum of Agreement allowing for deferred identification and evaluation of any historic properties identified in this portion of the APE (Pachter 2020). BOEM anticipates that if these investigations identify any significant cultural resources that Vineyard Wind would voluntarily implement plans to avoid, minimize, and/or mitigate impacts aligned with Massachusetts state requirements and the requirements of the NHPA. Considering these changes, the direct and indirect impacts of the Proposed Action on terrestrial cultural resources are still expected to be minor.

With incorporation of these design changes into the analysis, the Proposed Action would have negligible to minor impacts on most cultural resources, but would have moderate impacts on the Gay Head Lighthouse on Martha's Vineyard, the Chappaquiddick Island TCP, the Nantucket Island National Historic Landmark (NHL), and submerged paleolandform features within the WDA and the OECC.

Six IPFs or sub-IPFs in Table 3.9-1 were not discussed previously in the Draft EIS sections regarding cultural resources. Subsequent to publication of the Draft EIS, BOEM decided to specifically assess the potential impacts of accidental releases of fuel, fluids, hazardous materials, sediments, trash, and debris; anchoring, gear utilization, and dredging; introduction of anthropogenic light sources in the offshore environment; port expansion activities; beach restoration activities; and climate change on cultural resources.

The cumulative impacts on cultural resources of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities within the geographic analysis area for cultural resources are listed by IPF in Table 3.9-1. The most impactful IPFs would include light, presence of structures, and offshore construction.

The cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities would be of similar types as described in Section 3.9.1.1, but may differ in intensity and extent. If the Vineyard Wind 1 Project is not approved, it is assumed that the energy demand that the Vineyard Wind 1 Project would have filled would likely be met by other projects in remaining areas of the Massachusetts, Rhode Island, and/or New York leases. Although the impacts from a substitute project may differ in location and time, depending on where and when future offshore wind facilities are built out to meet the remaining demand, the nature of impacts and the total number of WTGs would be similar either with or without the Proposed Action, as described in Section 3.9.1.1. In other words, future offshore wind facilities capable of generating 9,404 MW would be built in the RI and MA Lease Areas, although, in the absence of the Proposed Action, none would be built before 2021.

Accidental releases: Accidental release of hazardous materials and trash/debris, if any, could affect cultural resources. The 59 WTG and ESP foundations for the Proposed Action would include storage for up to 24,157 gallons (93,715 liters) of coolants, 341,869 gallons (1.3 million liters) of oils and lubricants, and 50,897 gallons (192,666 liters) of diesel fuel. The volume of materials release is unlikely to require cleanup operations that would permanently impact cultural resources. As a result, the direct and indirect impacts of accidental releases from the Proposed Action on cultural resources would be short-term, localized, and negligible. Impacts from future offshore wind projects would be similar to those of the Proposed Action, but could occur throughout the RI and MA Lease Areas. Cumulatively, there would be a low risk of a leak of fuel, fluids, or hazmat from any of the approximately 775 WTGs and 20 ESPs associated with the No Action Alternative, which would include storage for up to 5.3 million gallons (20 million liters) of these substances. The cumulative impacts on cultural resources from accidental releases from the Proposed Action when combined with past, present, and reasonably foreseeable activities would have short-term, localized, and minor cumulative impacts on cultural resources.

Anchoring, gear utilization, and dredging: Extensive geophysical marine archaeological surveys were conducted in the Proposed Action WDA and along the OECC to identify marine cultural resources. These surveys identified two shipwrecks and five potential shipwrecks/debris fields. The Proposed Action has committed to avoiding these resources during construction, maintenance, and decommissioning activities. As a result, BOEM does not anticipate impacts on known shipwreck and debris field sites from development of the Proposed Action. As a result, anchoring, gear utilization, and dredging associated with the Proposed Action (4 acres [0.02 km^2]) would have negligible impacts on marine cultural resources, although larger impacts could occur if a previously undiscovered resource is affected.

In the expanded cumulative scenario, there could be up to 126 acres (0.5 km^2) of anchoring occurring within the geographic analysis area that could potentially affect cultural resources. BOEM anticipates that lead federal agencies and relevant state historic preservation offices would require the applicants for future offshore wind projects to conduct extensive geophysical remote sensing surveys (i.e., similar to those conducted for the Proposed Action) to identify and avoid marine cultural resources as part of NEPA and NHPA Section 106 compliance activities. This would include actions to avoid the 30 recorded wreck sites in the NOAA AWOIS and ENC located within the WDA lease blocks for the wind projects in the geographic analysis area of this study as well as studies to identify previously unrecorded sites (NOAA 2019c). BOEM would also continue to require developers to avoid impacts on any identified marine archaeological resources during construction, operation, and decommissioning or mitigate any impacts. As a result, the cumulative impact associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities, on shipwreck and debris field resources from anchoring, gear utilization, and dredging would be long-term, localized, and minor, unless previously undiscovered resources are affected.

Light: As previously discussed, development of the offshore wind industry would increase the amount of offshore anthropogenic light from vessels, area lighting during the construction and decommissioning of projects (to the degree that construction occurs at night), and the use of hazard/warning lighting on WTGs and ESPs during operations. The susceptibility and sensitivity of cultural resources to lighting impacts from the Proposed Action would vary based on the unique characteristics of individual cultural resources. Nighttime lighting impacts would be restricted to cultural resources for which a dark nighttime sky is a contributing element to their historic integrity and resources stakeholders use at night, and that do not generate a substantial amount of their own light pollution.

Examples of these types of resources in the geographic analysis area of this study include, the Chappaquiddick and Nantucket Sound TCPs.

Construction of the Proposed Action may require nighttime vessel and construction area lighting. The lighting impacts would be short-term as they would be limited to the construction phase of the Proposed Action. The intensity of nighttime construction lighting from the Proposed Action would be limited to the active construction area at any given time. Impacts would be further reduced by the distance between the nearest construction area (i.e., the closest line of WTGs) and the nearest cultural resources on Martha's Vineyard and Nantucket. The intensity of nighttime construction lighting would also decrease significantly during the construction of WTGs and ESPs further and further from shore as distance from the lighting source and resources increased. The intensity of lighting impacts would be further reduced by atmospheric and environmental conditions such as clouds, fog, and waves that could partially or completely obscure or diffuse sources of light. As previously stated, these impacts would be limited to cultural resources for which a dark nighttime sky is a contributing element to their historic integrity and/or resources used by stakeholders at night, limiting the scale of impacts on cultural resources. As a result, nighttime vessel and construction area lighting from the Proposed Action would have short-term, low intensity impacts on a limited number of resources, resulting in **minor** impacts on cultural resources.

As previously discussed, up to 12 different lease areas could be constructed from 2021 through 2030 (with up to four projects simultaneously under construction in 2022 and 2023) and some future offshore wind projects could require nighttime construction lighting. Construction lighting from any project would be temporary, lasting only during nighttime construction, and could be visible from shorelines and elevated locations. Sources of light would be limited to individual WTG or ESP sites under construction, rather than the entire RI and MA Lease Areas. Although the nighttime lighting impacts from individual projects would be short-term and distance and the number of WTGs and/or ESPs under construction would limit the intensity of individual nighttime construction impacts, construction of the 12 different lease areas would result in nighttime lighting impacts for nine years with the potential for multiple projects being simultaneously under construction. Similar to the Proposed Action, these impacts would be restricted to a limited number of cultural resources and the intensity of impacts would decrease with distance from the shoreline and 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 associated with the Proposed Action would have long-term, low intensity impacts on a limited number of resources, resulting in **minor** impacts on cultural resources.

Cultural resources would also be susceptible to nighttime and daytime lighting impacts from operations phase aviation hazard avoidance lighting on WTGs and ESPs. The use of standard aviation warning lights on the Proposed Action WTGs would result in long-term, continuous, **moderate** impacts on the cultural resources. Vineyard Wind has committed to voluntarily implementing ADLS to reduce operation phase nighttime lighting impacts. ADLS would only activate WTG lighting when aircraft enter a predefined airspace. For the Proposed Action, this was estimated to occur 235 times during the year, illuminating less than 0.1 percent of nighttime hours per year (Draft EIS Section 3.4.4.4). The use of ADLS by the Proposed Action would result in intermittent, low intensity (rather than continuous), **minor** impacts on cultural resources.

Up to 775 WTGs and 20 ESPs would be added by the development of future offshore wind projects within the geographic analysis area for cultural resources (assuming WTGs with a maximum blade tip height of 853 feet [260 meters]). Permanent aviation warning lighting would be required on all WTGs and ESPs built by future offshore wind projects. At night, the required aviation lighting would consist of red lights on the nacelle flashing 30 times per minute, as well as mid-tower red lights flashing at the same frequency. Studies cited in Draft EIS Section 3.4.4.4, suggest that, generally, hazard lighting on WTGs more than 15 miles (24.1 kilometers) from the viewer would have negligible impacts on the viewer. Depending on the selected location, a maximum of 38 WTGs are located within 15 miles (24.1 kilometers) of Martha's Vineyard and a maximum of 11 WTGs are within 15 miles (24.1 kilometers) of Nantucket, limiting the intensity of impacts from visible aviation hazard lights visible at night. Assuming future offshore wind developments do not commit to using ADLS systems, operational lighting from the Proposed Action, combined with past, present, and reasonably foreseeable activities, would have a long-term, continuous, **moderate** cumulative impacts on cultural resources. If ADLS systems were used by future offshore wind developments, cumulative nighttime hazard lighting impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities on cultural resources would be reduced to **minor**.

Port utilization: Expansion: The Proposed Action would make use of the state's ongoing investment in the MCT at the Port of New Bedford, as well as private investments at Vineyard Haven Harbor, but was not itself the impetus for any such investments. As stated in Draft EIS Section 3.4.6.3, these upgrades were undertaken in support of the Massachusetts/Rhode Island offshore wind industry as a whole. BOEM assumes that state and federal legal requirements to identify and assess—and to avoid, minimize, and/or mitigate—potential impacts on cultural resources were or would be followed as part of these expansions. As a result, the Proposed Action would have no impacts on cultural resources under this IPF. BOEM assumes that any port expansions necessitated by future offshore wind projects would also adhere to applicable regulations for evaluating and addressing impacts on cultural resources. Because the Proposed Action would have no direct and indirect impacts under this IPF, there would be no cumulative impacts.

Presence of structures: An Historic Properties Visual Impact Assessment for the Proposed Action determined that the construction of the WTGs would adversely affect three historic properties: the Gay Head Lighthouse; Chappaquiddick Island TCP; and the Nantucket Historic District National Historic Landmark comprising the islands of Nantucket, Tuckernuck, and Muskeget (COP Volume III, Appendix III-H.b; Epsilon 2020a). The study also 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 southern views from these resources. The Proposed Action would further mitigate viewshed impacts by taking the following actions:

- Avoiding use of the three turbine locations in the northwest corner of the WDA (i.e., those closest to Martha's Vineyard and Nantucket islands);
- Using non-reflective pure white and light grey paint on offshore structures; and
- Funding a mitigation plan to resolve impacts on the Gay Head Lighthouse pursuant to a Section 106 Memorandum of Agreement.

Vineyard Wind has also committed to fund specific mitigation projects on the Nantucket NHL. Nonetheless, an uninterrupted sea view free of modern visual elements is a contributing element to NRHP eligibility of the Gay Head Lighthouse, Nantucket NHL, and Chappaquiddick Island TCP historic properties. As a result, the presence of visible WTGs from the Proposed Action structures would have long-term, continuous, widespread, **moderate** impacts on these resources.

BOEM conducted a Historic Properties Cumulative Visual Impact Assessment to assess the cumulative visual impacts on the Gay Head Lighthouse, Nantucket NHL, and Chappaquiddick Island TCP historic properties from the Proposed Action and the future offshore wind projects (ERM 2020). The cumulative impact assessment determined the maximum and average number of WTGs from the Proposed Action and future offshore wind projects that could be theoretically visible from each of the three historic properties affected by the Proposed Action (based on distance, topography, vegetation, and intervening structures). The study also calculated the percentage of the total resource area from which at least one WTG would be visible (i.e., the percentage of the total land area of the resources where a viewer would be able to see one or more WTGs). The study assessed these values using the tip of the blade height for 14-MW (853 feet) and 12-MW (837 feet) turbines in order to simulate the maximum number of WTGs that could be theoretically visible from the Proposed Action and future offshore wind projects. The study also calculated the same values using the nacelle heights of the 14-MW (514 feet) and 12-MW (496 feet) turbines. Since the nacelle heights would be lower than the blade tips, the number of theoretically visible WTGs would be lower. Table 3.9-2 contains a summary of the study findings based on the blade tip analysis.

The historic properties cumulative visual impact assessment study demonstrates that portions of over 580 WTGs could theoretically be visible from select, high elevations at each of these resources. Substantially fewer WTGs would be visible from lower elevations or locations without clear seaward views. The Gay Head Lighthouse would be subject to the largest scale impacts of the three resources, with portions of a maximum of 585 WTGs theoretically visible from the resource, an average of 200 WTGs theoretically visible from across the resource area, and with at least one WTG theoretically visible from 76 percent of the resource area—at an average distance of 25.8 miles (41.5 kilometers). The study also demonstrates, however, that the Nantucket NHL and Chappaquiddick TCP would be subject to comparatively smaller scale, less intense cumulative viewshed impacts. Portions of a maximum of 651 and 646 WTGs (respectively) could be theoretically visible at an average distance of 28.68 to 27.81 miles (respectively) (46.15 to 44.76 kilometers), from select, high-elevation locations within these resources, but the average number of WTGs theoretically visible across the resources would be relatively low, ranging from 16 to 38 WTGs. In addition, the study indicates that viewers would not be able to see any WTGs from approximately 59 percent of locations within the Chappaquiddick TCP and 84 percent of locations within the Nantucket NHL, demonstrating the limited geographic extent of cumulative visual impacts from the Proposed Action and No Action Alternative.

In addition to the limited geographic extent of impacts, the intensity of visual impacts on these historic properties would be limited by distance, environmental, and atmospheric factors. Due to the distances between the historic properties and the WDAs, the WTGs from the Proposed Action and future offshore wind projects would appear relatively small to an observer, appearing to be less than one-tenth of an inch (0.1 inch [0.255 to 0.282 centimeters]) tall on the horizon. As discussed in Section 3.9.1.1, the visibility of WTGs would be further reduced by environmental and atmospheric factors such as cloud cover, haze, sea spray, vegetation, and wave height (COP Volume III, Appendix III-H.b; Epsilon 2020a). While these factors would limit the intensity of impacts, the presence of visible WTGs from the Proposed Action when combined with past, present, and reasonably foreseeable activities would have long-term, continuous, **moderate** impacts on the three historic properties listed above.

New cable emplacement/maintenance: The Proposed Action would result in construction of up to 57 WTGs and 2 ESPs, as well as jet plow embedment with limited dredging for and installation of an OECC and an inter-array cable system. Marine geophysical remote sensing studies performed for the Proposed Action identified two shipwrecks, five potentially significant debris fields, and 35 paleolandform features that may represent cultural resources within the WDA and OECC (233 acres [0.9 km^2] of seafloor disturbance). Vineyard Wind has committed to avoiding the shipwrecks and debris fields, and would not impact these resources. As a result, and as stated in Draft EIS Section 3.4.3.3, BOEM determined that the Proposed Action would have long-term, localized, **negligible** impacts on shipwreck and debris field cultural resources. Vineyard Wind has also committed to removing one WTG placement location and rerouting the WDA inter-array cables to avoid 19 of the 35 paleolandform features identified in the WDA and OECC (COP Volume II-C; Epsilon 2019b). Construction of the Proposed Action would result in large-scale, permanent impacts on the remaining 16 paleolandform features that could not be avoided. For those unavoidable paleolandform features corresponding to the time of human occupation, additional mitigations would be performed, as codified in a Section 106 Memorandum of Agreement. Vineyard Wind has committed to working with the consulting parties, Native American Tribes, BOEM, and the MHC to develop a specific treatment plan for mitigating impacts on unavoidable paleolandform features. As stated in Draft EIS Section 3.4.3.11, implementation of a treatment plan agreed to by all parties would likely reduce the magnitude of impacts on paleolandform features from **major** to result **moderate** impacts on paleolandform features.

Using the assumptions in Appendix A, Table A-4, future offshore wind projects would result in construction of 775 WTGs and 20 ESPs, as well as inter-array cable systems, and OECCs (3,398 acres [13,751 m^2] of seabed disturbance). The marine geophysical and geotechnical studies conducted for the Proposed Action, a 2012 BOEM study (TRC 2012), and the NOAA AWOIS and ENC databases suggest that the entire RI and MA Lease Areas covers areas with high probability for containing submerged paleolandform features and shipwrecks (TRC 2012). As with the Proposed Action, future 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. As with the Proposed Action, other projects would likely be unable to avoid impacts on all paleolandform features. Cumulative impacts on cultural resources from offshore construction associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would have localized, long-term, **minor** impacts on shipwrecks, downed aircraft, and debris fields, and long-term, widespread, unmitigated, **major** impacts on paleolandform features. BOEM has committed to working with Applicants, consulting parties, Native American tribes, and the MHC to develop specific treatment plans to address impacts on paleolandform features that cannot be avoided by future offshore wind development projects. Development and implementation of project specific treatment plans, agreed to by all consulting parties would likely reduce the magnitude of unmitigated impacts on paleolandform features from **major** to **moderate** impacts.

Land disturbance: As discussed in Draft EIS Section 3.4.3.11, Vineyard Wind's onshore cultural resource investigations determined that the Proposed Action would not impact any terrestrial cultural resources. Vineyard Wind has committed to conducting archaeological monitoring during construction in areas previously determined to have a moderate to high potential for undiscovered archaeological resources. Subsequent to issuance of the Draft EIS, Vineyard Wind expanded the onshore substation design and would need an additional approximate 2.2 acres (8,903 m^2) along the west side of the original 6.4-acre (25,900-m^2) substation site. Vineyard Wind has stated that the majority of the 2.2-acre (8,903-m^2) area has been previously disturbed but 0.64 acre (2,428 m^2) would need to be investigated for cultural resources as described above. BOEM anticipates that if these investigations identify any significant cultural resources, Vineyard Wind would voluntarily implement plans to avoid, minimize, and/or mitigate impacts aligned with Massachusetts state requirements and the requirements of the NHPA. As a result, and considering the possible presence of undiscovered resources, onshore construction of the Proposed Action would have localized, long-term, **minor** impacts on terrestrial cultural resources.

Construction of onshore components for future offshore wind developments could result in impacts on known cultural resources and undiscovered cultural resources (if present). Ground-disturbing construction activities could impact undiscovered archaeological sites, while construction of aboveground infrastructure could impact known historic structures due to the introduction of modern visual elements. Underground and aboveground components could also impact TCPs, if present. BOEM anticipates that federal (i.e., NEPA and NHPA Section 106) and state level requirements to identify cultural resources, assess impacts, and implement measures to avoid, minimize, and/or mitigate impacts would minimize impacts on cultural resources from the reasonably foreseeable wind developments. As a result, construction of the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in localized, long-term, **minor** impacts on terrestrial cultural resources.

Climate change: Operation of the Proposed Action would marginally reduce or displace emissions from conventional power generation, thereby contributing to slowing or arresting global warming and associated climate change and also having a long-term, **negligible** to **minor beneficial** impact cultural resources. Future offshore wind projects would have similar beneficial impacts, on a larger scale. Due to the relatively small contribution of the offshore projects, compared to global emissions, the magnitude of these **beneficial** impacts would remain **negligible** to **minor**.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from **negligible** to **major**. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in **moderate** cumulative impacts on cultural resources due to the long-term or permanent and irreversible impacts on the Gay Head Lighthouse, Chappaquiddick TCP, Nantucket NHL, and paleolandform features. Higher cumulative impacts, ranging from **moderate** to **major**, would occur without the pre-construction NHPA requirements to identify historic properties, assess potential effects, and develop treatment plans to resolve effects through avoidance, minimization, and/or mitigation. These NHPA-required, "good faith" efforts to identify historic properties and address impacts resulted in or contributed to Vineyard Wind making a number of commitments to reduce the magnitude of impacts on cultural resources, including, but not limited to, the use of ADLS hazard lighting (if approved), the relocation of three WTG positions, rerouting the OECC and inter-array cable systems, non-reflective pure white and light grey paint on offshore structures, funding mitigation measures for the Gay Head Lighthouse, and the development of a treatment plan with consulting parties to address impacts on paleolandform features (Draft EIS Appendix D). BOEM anticipates that NHPA requirements to identify historic properties and resolve any effects would similarly reduce the significance of potential impacts on cultural resources from the future offshore wind projects as they complete the NHPA Section 106 review process. Thus, the overall cumulative impacts on cultural resources would likely qualify as moderate because a notable and measurable impact is anticipated, but the resource would likely recover completely when the impacting agent were gone and/or remedial or mitigating action were taken.

3.9.2.2. Cumulative Impacts of Alternatives B, C, D1, and D2

The direct and indirect impacts of Alternatives B, C, D1, and D2 on cultural resources are described in Draft EIS Sections 3.4.3.4 through 3.4.3.7. These impacts have been revised to reflect the use of 14-MW WTGs; the difference between Alternative B and the Proposed Action is that Alternative B would not use the New Hampshire Avenue landfall site, and would eliminate the need for the eastern OECR. As a result, Alternative B would avoid impacts on the six archaeological sites identified along the eastern OECR. In other respects, the direct and indirect impacts of Alternative B on demographics, employment, and economics would be the same as those of the Proposed Action.

Accordingly, the direct and indirect impacts resulting from individual IPFs associated with Alternatives B, C, D1, and D2 on cultural resources would be the same as those of the Proposed Action: **negligible** to **minor** impacts, except for potentially **moderate** impacts on paleolandform features and the Gay Head Lighthouse, Nantucket NHL, and Chappaquiddick Island TCP historic properties.

The cumulative impacts of Alternative B would be lower than those of the Proposed Action because of the avoidance of impacts along the eastern OECC route and in Lewis Bay; however, the overall cumulative impacts of Alternatives B, C, D1, and D2 would still be similar to those of the Proposed Action, with individual IPFs generating **negligible** to **minor** impacts for some IPFs, and potentially **moderate** impacts on paleolandform features and the Gay Head Lighthouse, Nantucket NHL, and Chappaquiddick Island TCP historic properties. The overall cumulative impacts of each alternative, when combined with past, present, and reasonably foreseeable activities on cultural resources would be **moderate** due to the long-term or permanent and irreversible impacts on the Gay Head Lighthouse, Chappaquiddick TCP, Nantucket NHL, and paleolandform features.

3.9.2.3. Cumulative Impacts of Alternative E

The direct and indirect impacts of Alternative E on cultural resources are described in Draft EIS Section 3.4.3.7. Alternative E would entail the construction of 57 to 84 WTGs, each with generation capacity ranging from approximately 9.5 to 14 MW. Because Alternative E could involve a greater number of WTG foundations, it could increase seafloor disturbance, compared to the Proposed Action, resulting in larger impacts on cultural resources: **minor** to **moderate**, overall.

Cumulative impacts of Alternative E would be very similar to those of the Proposed Action, as discussed in the preceding paragraphs, with individual IPFs leading to impacts ranging from **negligible** to **minor** for some IPFs, potentially **moderate** impacts on paleolandform features and the Gay Head Lighthouse, Nantucket NHL, and Chappaquiddick Island TCP historic properties. The overall cumulative impacts of Alternative E when combined with past, present, and reasonably foreseeable activities on cultural resources would be **moderate** due to the long-term or permanent and irreversible impacts on the Gay Head Lighthouse, Chappaquiddick TCP, Nantucket NHL, and paleolandform features.

3.9.2.4. Direct, Indirect, and Cumulative Impacts of Alternative F

Alternative F analyzes a vessel transit lane through the WDA, in which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The WTGs that would have been located within the transit lane would not be eliminated from the Proposed Action; instead, the displaced WTGs would be shifted to locations south within the Lease Area. Under this alternative, BOEM is analyzing a 2- and 4-nautical-mile northwest/southeast vessel transit lane through the WDA combined with any action alternative; however this analysis focuses on the combination of Alternative F with either the Proposed Action or Alternative D2 layout. Therefore, the number of turbines would remain the same. The northern transit lane within the WDA could result in the relocation of 16 to 34 WTG placements further offshore, a 12 to 61 percent increase in the size of the WDA further south (depending on whether the Proposed Action or Alternative D2 layout is used and how wide the transit lane is), and an associated increase the amount of inter-array cables and OECC due to the placement of WTGs further south in the lease area. The direct and indirect impacts of Alternative F on the Gay Head Lighthouse, Nantucket NHL, and Chappaquiddick TCP would be similar to the Proposed Action, although there could be incremental reductions in visual impacts based on final WTG locations. Alternative F would also likely result in similar impacts on shipwreck, down aircraft, and associated debris fields as BOEM would require additional marine cultural resource surveys to identify and avoid these types of resources. The direct and indirect impacts from the combination of the new Alternative F with Alternative A or Alternative D2 is expected to be similar to combinations with the other alternatives. Consequently, these other potential combinations are not separately analyzed here.

Selection of Alternative F would likely result in similar impacts on paleolandform features. While an increase in the length of the OECC and expansion of the inter-array cable network could increase the geographic extent and the number of paleolandform features impacted, this could be partially offset by the relocation of WTGs from the transit lane area and associated inter-array cabling further offshore to portions of the WDA with a lower potential to contain archaeologically significant paleolandform features. In 2013 BOEM commissioned a study to develop a paleogeographic reconstruction of relative sea level and the approximate locations of paleoshorelines within the Massachusetts Lease Areas beginning circa 19,000 years before present (B.P.) (Bright et al. 2013). The study indicated that the entire Massachusetts Lease Areas was submerged by 10,000 B.P., and as a result could have been inhabited by native tribal peoples during the Paleoindian (12,500 to 10,000 B.P.), Late Paleoindian (10,500 to 9,500 B.P.), and Early Archaic (10,000 to 7,500 B.P.) periods (Bright et al. 2013). The study also demonstrated that because the inundation of the Massachusetts Lease Areas proceeded from southwest to northeast that the potential length of native tribal occupation was not uniform. The southern and eastern half of the Massachusetts Lease Areas could only have been occupied until circa 11,000 B.P., while portions of the northern and western half could have been occupied for an additional eleven hundred years. This difference in the relative lengths of potential occupation suggests that the southern and western portions of the Massachusetts Lease Areas contain fewer archaeological resources compared to the northern and eastern portions.

As a result, if the Alternative F relocation of 16 to 34 WTG placements and 12 to 61 percent increase in the size of the WDA decreases seafloor impacts closer to shore and increases impacts further offshore, it could reduce the number of archaeological resources affected by impacts on paleolandform features by relocating impacts on areas with fewer archaeological resources. Although these areas would have a lower potential for containing archaeologically significant paleolandform features, the associated increase in the length of the OECC and inter-array cables could offset any benefits from relocating infrastructure further offshore by increasing the likelihood that paleolandform features would be impacted by increasing the size of the impact area. Due to these offsetting factors, the likely impacts on paleolandform features from the Alternative F are anticipated to be similar to the Proposed Action.

As a result, the impacts of Alternative F on cultural resources would likely be similar to those of the Proposed Action. Vineyard Wind will complete marine archaeological surveys prior to construction, and assuming they are able to avoid any identified shipwreck, downed aircraft, and associated debris fields, the impacts of Alternative F on these resources would likely be of the same magnitude as the Proposed Action. Expansion of the WDA and an increase the extent of inter-array cable system under Alternative F could increase the number, extent, and scale of impacts on paleolandform features. This potential increase would, however, be likely offset by relocating infrastructure into portions of the WDA with a lower potential for containing archaeologically significant paleolandform features. In addition, if the selection of Alternative F lead to an increase in impacts on paleolandform features, BOEM would require additional actions within the planned treatment plan developed to address adverse effects on these resources and, as a result the mitigated impacts of Alternative F on paleolandform features would be similar to those of the Proposed Action. As a result, direct and indirect impacts resulting from individual IPFs associated with Alternative F would likely result in: **negligible** to **minor** impacts on shipwreck, downed aircraft, and associated debris field resources and **moderate** impacts on paleolandform features.

In considering the cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities, BOEM assumes for the purposes of this analysis that the transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. Cumulative impacts of Alternative F would be very similar to those of the Proposed Action, as discussed in the preceding paragraphs, with individual IPFs leading to impacts ranging from **negligible** to **minor** for some IPFs, and potentially **moderate** impacts on paleolandform features and the Gay Head Lighthouse, Nantucket NHL, and Chappaquiddick Island TCP historic properties. The overall cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities on cultural resources would be **moderate** due to the long-term or permanent and irreversible impacts on the Gay Head Lighthouse, Chappaquiddick TCP, Nantucket NHL, and paleolandform features.

BOEM has qualitatively evaluated the cumulative impacts of implementing all six RODA-recommended transit lanes, including the northern transit lane described for Alternative F, as well as five other transit lanes through the RI and MA Lease Areas. To the extent additional transit lanes are implemented in the future outside the WDA as part of RODA's suggestion, the WTGs for future offshore wind projects may need to be located further from shore. If in the future all six transit lanes were implemented, the overall number of WTGs would decreased but would lead to increased impacts on paleolandform features from longer OECC routes, as well as installation of WTGs in areas further offshore with fewer archaeological resources. The significance of these impacts may be somewhat reduced as the potential for impacting archaeological resources within paleolandform features decreases with increased distance from shore.

3.9.2.5. Comparison of Alternatives

As discussed in Draft EIS Section 3.4.3.9, and except as discussed below, most alternatives would have similar levels of impact on cultural resources: **negligible** to **minor** impacts, except for potentially **moderate** impacts on paleolandform features and the Gay Head Lighthouse, Nantucket NHL, and Chappaquiddick Island TCP historic properties. Alternative B would avoid impacts on marine archaeological resources along the eastern OECC route and in Lewis Bay; however the level of impacts would remain the same. Alternatives C and F could have marginally lower indirect impacts on the Gay Head Lighthouse, Nantucket NHL, and Chappaquiddick TCP, due to reduced visual impacts, depending on WTG placement. Alternatives D, E, and F could have increased impacts on marine archaeological resources, due to increased seafloor surface disturbance.

Accidental releases; anchoring, gear use, and dredging; light; port expansion; presence of structures; offshore construction; and other IPFs of the Proposed Action, when combined with past, present, and reasonably foreseeable activities, could result in cumulative impacts whenever the resource is stressed before it has completely recovered from previous impacts. Cumulative impacts under any action alternative would likely be very similar because the majority of the cumulative impacts of any alternative come from future offshore wind development, which does not change between alternatives. BOEM expects cultural resources to continue to be affected by regional commercial, industrial, and recreational activities including future offshore wind projects. The impacts would be geographically limited to marine and terrestrial archaeological resource within onshore and offshore construction areas and historic standing structures with views of offshore and onshore wind components, for which an uninterrupted sea view, free of modern visual elements, is a contributing element to NRHP eligibility. BOEM anticipates, however, that implementation of existing state and federal cultural resource laws and regulations would significantly reduce the magnitude of impacts on cultural resources due to requirements to avoid, minimize, and/or mitigate project-specific impacts on cultural resources.

Cumulative impacts on cultural resources from the IPFs associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in **moderate** impacts on cultural resources. Impacts on cultural resources from specific IPFs would range from **negligible** to **moderate**: **negligible** to **minor** impacts on terrestrial archaeological resources, historic standing structures, shipwrecks, downed aircraft, and associated debris fields and **moderate** impacts on paleolandform features. The cumulative impacts of Alternatives B, C, D, and F would be very similar to those of the Proposed Action: **negligible** to **minor** impacts on some cultural resources, except for potentially **moderate** impacts on paleolandform features and the Gay Head Lighthouse, Nantucket NHL, and Chappaquiddick Island TCP historic properties. The cumulative impacts of Alternative E on cultural resources, when combined with past, present, and reasonably foreseeable activities, would be larger than those of the Proposed Action: **minor** to **moderate** impacts overall. Alternative B would be lower cumulatively as a part of the Proposed Action would avoid cultural resources with the use of Covell's Beach. Alternative C would be similar to the Proposed Action in cumulative impacts but could result in reduced visual impacts on the Gay Head Lighthouse, the Chappaquiddick Island TCP, and the Nantucket NHL. Alternatives D, E, and F would be similar with the exception of a potential increase in the number, extent, and scale of impacts on paleolandform features, which would likely be mitigated through additional actions in the planned treatment plan to address effects on these resources.

In conclusion, the cumulative impacts of any alternative on cultural resources, when combined with past, present, and reasonably foreseeable activities, would be **moderate.** The main driver for this is due to the long-term or permanent and irreversible impacts on the Gay Head Lighthouse, Chappaquiddick TCP, Nantucket NHL, and paleolandform features.

3.10. Recreation and Tourism

3.10.1. No Action Alternative Impacts

Table 3.10-1 contains a detailed summary of the baseline conditions and the impacts of ongoing and future offshore activities other than offshore wind on recreation and tourism, based on the IPFs assessed. This information comes primarily from the Draft EIS, supplemented by information developed in responding to comments on the Draft EIS and additional information. The impact analysis is limited to impacts within the geographic analysis area for recreation and tourism as described in Table A-1 and shown on Figure A.7-9 in Appendix A. Specifically, this includes the RI and MA Lease Areas plus a 35.3-mile (56.8-kilometer) area measured from the borders of the proposed Project WDA, which is the area from which any portion of the proposed Project structures would potentially be visible based only on the obscuring effect of the curvature of the earth's surface.

The scenic quality of the coastal environment is important to the identity, attraction, and economic health of many of the coastal communities. The visual qualities of historic coastal towns, which include marine activities within small-scale harbors, and the ability to view birds and marine life, are important community characteristics. Recreational and tourist-oriented activities in the geographic analysis area are oriented toward the southern coast of Cape Cod and around Martha's Vineyard, Nantucket, and the nearby small islands. Water-oriented recreational activities include boating, visiting beaches, hiking, fishing, shellfishing, and bird and wildlife viewing. Boating covers a wide range of activities, from ocean-going vessels to small boats used by residents and tourists in sheltered waters, and includes sailing, sailboat races, fishing, shellfishing, kayaking, canoeing, and paddleboarding. Future offshore activities other than offshore wind would have only localized, temporary impacts on recreational boating and would not affect the area's scenic quality.

Offshore fishing is an important component of recreation and tourism in the geographic analysis area, with most trips originating from Massachusetts and nearby coastal states. Although data specific to the geographic analysis area are not available, more than 5.2 million residents of Atlantic coast states participated in marine recreational fishing in 2018, accounting for over 129 million trips and 574 million fish caught. About 5 percent of these trips (approximately 6.7 million trips), originated in Massachusetts and 13 percent (about 17.3 million trips) originated in the nearby states of New York, Connecticut, and Rhode Island.[10] The most commonly caught non-bait species (in numbers of fish) were striped bass, spotted seatrout, black sea bass, bluefish, and scup. The largest harvests by weight were striped bass, dolphinfish, bluefish, scup, and black sea bass (NOAA 2018).

Fishing for Atlantic HMS, defined as federally regulated sharks, blue and white marlin, sailfish, roundscale spearfish, swordfish, and federally regulated tunas, occurs further offshore than most other recreational fishing, and is therefore more likely to overlap with areas where future offshore wind development would occur. There were 20,020 angling permit holders for Atlantic HMS in 2016. Atlantic HMS Angling permits are issued to a vessel, and authorize anyone fishing from that vessel to fish for federally regulated HMS (NMFS 2019a). In 2016, 14 percent of HMS angling trips began in Massachusetts; only Florida (16 percent of trips) had a higher percentage of trip originations. Three percent of trips began in Rhode Island (NMFS 2019a).

Under the No Action Alternative, the proposed Project would not be built and hence would have no impact on resources related to recreation and tourism. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. If the Vineyard Wind 1 Project is not approved, then impacts from the proposed Project would not occur as proposed. However, the state demand that the Vineyard Wind 1 Project would have filled, if approved, could likely be met by other projects in the geographic analysis area for recreation and tourism. Therefore, the impacts on recreation and tourism would be similar, but the exact impact 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 and considers the assumptions included in Section 1.2 and Appendix A. A detailed analysis of impacts associated with future offshore wind development is provided in Section 3.10.1.1 and summarized in Table 3.10-1. Cumulative impacts of the Proposed Action and action alternatives are analyzed in Section 3.10.2.

3.10.1.1. Future Offshore Wind Activities (without Proposed Action)

BOEM expects these future offshore wind activities to affect recreation and tourism through the following primary IPFs. The maximum-case scenario for recreation and tourism differs depending on the specific topic:

- Impacts on recreational fishing and boating (as discussed for the Presence of structures IPF) are based on the state demand within the RI and MA Lease Areas being met using only 8-MW WTGs. This would result in a total of 957 WTGs and 20 ESPs, for a total of 977 foundations in the RI and MA Lease Areas.
- All other IPFs and impacts assume that the state demand within the RI and MA Lease Areas would be satisfied using 12 or 14-MW WTGs, resulting in a total of 775 WTGs and 20 ESPs, for a total of 795 foundations.

Anchoring: This IPF would potentially impact recreational boating both through the presence of an increased number of anchored vessels within the geographic analysis area and through the creation of offshore areas where recreational vessels may experience limitations or difficulty in anchoring.

Increased vessel anchoring during development of future offshore wind between 2021 and 2030 would affect recreational boaters. The greatest volume of anchored vessels would occur in offshore work areas during construction. The Vineyard Wind 1 COP estimated that an average of 25 and a maximum of 46 vessels would be present at the offshore WDA at any given time during construction, including an average of four and a maximum of six vessels deployed along sections of the OECC during installation (COP Volume III, Section 7.8.2.1.2 and Appendix III-I; Epsilon 2018a). Future offshore wind projects may generate similar numbers of active and/or anchored vessels, depending on project size and construction schedule. Most anchored, construction-related vessels are likely to be within temporary safety zones established in coordination with the USCG for active construction areas. Future offshore wind development in the geographic analysis area is anticipated to result in increased survey activity and overlapping construction periods beginning in 2021, with as many as four projects under construction at one time between 2021 and 2024, with others in surveying, permitting, or operational phases.

[10] The FEIS will provide additional data, as available, on coastal origination (ports and harbors) and species of interest for private recreational fishing in the offshore area affected by the Proposed Action. Section 3.11 discusses for-hire recreational fishing.

Vessel anchoring would also occur during maintenance and monitoring during operations. Following construction of future offshore projects (if approved), the presence of about 12 operating offshore wind projects in the geographic analysis area would result in a long-term increase in the number of vessels anchored during periodic maintenance and monitoring.

Anchored construction, survey, or service vessels would have localized, temporary, impacts on recreational boating. Recreational vessels could navigate around anchored vessels with only brief inconvenience. The temporary turbidity from anchoring would briefly alter the behavior of species important to recreational fishing (Section 3.10.1) and sightseeing (primarily whales, but also dolphins and seals). Inconvenience and navigational complexity for recreational vessels would be localized, variable, and long-term with increased frequency of anchored vessels during surveying and construction, and reduced frequency of anchored vessels during operations.

Light: Nighttime vessel lighting would be used if future offshore wind development projects include nighttime construction or material transport. In a maximum-case scenario, lights could be active throughout nighttime hours for up to four future offshore wind projects within the geographic analysis area simultaneously under active construction. Vessel lighting would enable recreational boaters to safely avoid nighttime construction areas. The impact on recreational boaters would be localized, sporadic, short-term, and minimized by the limited offshore recreational activities that occur at night.

Permanent aviation warning lighting required on the WTGs would be visible from south-facing beaches and coastlines within the geographic analysis area, and could have indirect impacts on recreation and tourism in certain locations if the lighting influences decisions of visitors in selecting coastal locations to visit. At night, required aviation lighting on the WTGs would consist of red lights on the nacelle flashing 30 times per minute, as well as mid-tower red lights flashing at the same frequency. Based on an assumed nacelle-top height of 514 feet (156.7 meters) AMSL, the nacelle-top warning lights on WTGs could theoretically be visible from up to approximately 35 miles (56 kilometers) away from viewers standing on the shore (farther for viewers from elevated positions). As a result, warning lighting from up to 709 WTGs could theoretically be visible within the geographic analysis area, depending on viewer location, intervening vegetation and topography, and atmospheric conditions. Studies cited in Draft EIS Section 3.4.4.4 suggest that, generally, WTGs visible more than 15 miles (24.1 kilometers) (from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity. The studies indicate that nighttime views of aviation hazard lighting for WTGs close to shore (5 to 8 miles [8 to 13 kilometers]) would adversely impact the rental price of properties with ocean views (Lutzeyer et al. 2017), but do not specifically address the relationship between lighting, nighttime views, and tourism for WTGs 15 or more miles (24.1 or more kilometers) from shore. More than 95 percent of the WTG positions envisioned in the geographic analysis area would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs.

The southern shores of Martha's Vineyard and Nantucket located within the viewshed of the WTG lights include landscapes characterized by open beaches, coastal dunes, bluffs, and salt ponds/tidal marshes. Residential and nonresidential development intended for recreational use are widely scattered in this area. Other visible infrastructure includes utility lines and roadways. Because of the low development density, existing nighttime lighting is limited. Impacts on the visual character and viewer experience of the nighttime landscape would be more pronounced for views along the southern shores of Martha's Vineyard and Nantucket that can be currently characterized as undeveloped, where lighting from human infrastructure and activities is not dominant or even not visible at all. Visible aviation warning lighting would add a developed/industrial visual element to views that were previously characterized by dark, open ocean, broken only by transient lighted vessels and aircraft passing through the view.

As a result, although lighting on WTGs would have a continuous, long-term, adverse impact on recreation and tourism, the impact in the geographic analysis area is likely to be limited to individual decisions by visitors to south-facing coastal and elevated areas, with less impact on the recreation and tourism industry as a whole.

ADLS is an emerging technology that could be utilized for wind facilities in the RI and MA Lease Areas. If implemented, ADLS would only activate WTG lighting when aircraft enter a predefined airspace. For the Proposed Action, this was estimated to occur 235 times during the year, with illuminating less than 0.1 percent of nighttime hours per year (Draft EIS Section 3.4.4.4). Depending on exact location and layout, ADLS would likely result in similar limits on the frequency of WTG aviation warning lighting use for future offshore wind projects. Implementation of ADLS could thus reduce the amount of time that WTG lighting is visible, thereby making WTG lighting visible only sporadically, rather than continuously at night. This would significantly reduce the already minimal impacts on recreation and tourism associated with lighting on WTGs.

New cable emplacement and maintenance: Under the No Action Alternative, future offshore wind export cables from the RI and MA Lease Areas could cross 1,310 miles (2,108 kilometers), while inter-array cables could total 1,480 miles (2,382 kilometers). Specific cable locations associated with future offshore wind projects are unknown, and therefore have not been identified within the geographic analysis area, with the exception of the Vineyard Wind 2 Project cable, which would use the same offshore cable corridor as the Proposed Action. Cables for other future offshore wind projects would likely be emplaced within the geographic analysis area between 2021 and 2030 and using the assumptions in Appendix A, there could be up to 3,400 acres (13.7 km^2). Cables for the Equinor and Mayflower offshore wind projects would cross Nantucket Sound; cables for Bay State Wind would be in the geographic analysis area but not within Nantucket Sound.

Offshore cable emplacement for future 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 (Table A-1 in Appendix A). 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 impact recreational boating only during maintenance operations, except that the mattresses covering cables in hard-bottom areas could hinder anchoring and result in gear entanglement or loss.

Impacts of cable emplacement and maintenance on recreational boating and tourism would be short-term, continuous, adverse, and localized.

Noise: Noise from construction, pile driving, G&G survey activities, trenching, operations and maintenance, and vessels could result in direct and indirect, adverse impacts on recreation and tourism.

Onshore construction noise from cable installation at the landfall sites, and inland if cable routes are near parkland, recreation areas, or other areas of public interest, would temporarily disturb the quiet enjoyment of the site (in locations where such quiet is an expected or typical condition). Similarly, offshore noise from G&G survey activities, pile driving, trenching, and construction-related vessels would intrude upon the natural sounds of the marine environment. This noise could cause some boaters to avoid areas of noise-generating activity, although the most intense noise would be within the safety zones that are already off-limits to boaters. Noise from pile driving, the noisiest aspect of WTG installation, is estimated to be 60 dB on the A-weighted scale at a distance of 1 nautical mile from the construction zone (COP Appendix III-I, Section 7.5.1.1; Epsilon 2018a), comparable to the noise level of a normal conversation (OSHA 2011).

During operations, the continuous noise generated by WTG operation, as measured at the Block Island Wind Farm, minimally exceeds ambient levels at 164 feet (35.4 meters) from the WTG base. In addition, based on the results of Thomsen et al. (2015) and Kraus et al. (2016b), sound pressure levels would be expected to be at or below ambient levels at relatively short distances from WTG foundations. Maintenance operations could temporarily produce localized noise.

Accordingly, the direct impact of noise on recreation and tourism during construction would be adverse, intense and disruptive, but short term and localized. Multiple construction projects at the same time would increase the number of locations within the geographic analysis area that experience noise disruptions. The direct impact of noise during operation and maintenance would be localized, continuous, and long-term, with brief more intensive noise during occasional repair activities.

Indirect, adverse impacts of noise on recreation and tourism would result from the direct, adverse impacts on species important to recreational fishing and sightseeing within the RI and MA Lease Areas and along OECC routes, as discussed in Sections 3.4, 3.5, and 3.11. G&G survey noise and pile driving would cause the most impactful noises. Because most recreational fishing takes place closer to shore than the RI and MA Lease Areas, only a small proportion of recreational fishing would be impacted by the construction within the RI and MA Lease Areas, where most of the noise impacts would occur. Recreational fishing for HMS such as tuna, shark, and marlin are more likely to be impacted, as these fisheries are farther offshore than most fisheries and, therefore, are more likely to experience temporary impacts resulting from the noise generated by future offshore wind construction. Construction noise could contribute to temporary impacts on marine mammals, with resulting indirect impacts on marine sightseeing that relies on the presence of mammals, primarily whales. However, as noted in Section 3.5, BMPs can minimize exposure of individual mammals to harmful impacts and avoid measurable, population-level effects.

Noise from operational WTGs would have little effect on finfish, invertebrates, and marine mammals; therefore, little indirect effect on recreational fishing or sightseeing.

Future offshore wind surveying and construction would occur within the geographic analysis area between 2021 and 2030. Based on the discussion above, future offshore wind construction would result in short-term, localized, indirect, adverse impacts on recreational fishing and marine sightseeing related to fish and marine mammal populations. Multiple construction projects would increase the spatial and temporal extent of temporary disturbance to marine species within the geographic analysis area. BOEM's assumed construction schedule for future offshore wind projects in Table A-6 in Appendix A indicates the possibility of up to four wind projects simultaneously under development in the RI and MA Lease Areas. As indicated in Appendix A, up to775 offshore WTGs and 20 ESPs could be installed within a 6- to 10-year period within the RI and MA Lease Areas. No long-term, adverse impacts are anticipated, provided mitigation measures are implemented to prevent population-level harm to fish and marine mammal populations.

Port utilization: The geographic analysis area for recreation and tourism contains no ports anticipated to be used for staging and construction support for future offshore wind development, although the area does include Vineyard Haven Harbor, which would be used by the Proposed Action for operational support. Ports outside the geographic analysis area for recreation and tourism that are likely to be used for staging and construction, such as New Bedford, Brayton Point, ProvPort, and Davisville/Quonset Point, may provide facilities for recreational vessels, or may be on waterways shared with recreational marinas, and may experience increased activity and undergo expansion and dredging. The ports listed above and other northeast ports suitable for staging and construction of the No Action Alternative are primarily industrial in character, with recreational activity as a secondary use. Port improvements could result in short-term delays and crowding during construction, but would provide long-term benefit to recreational boating if the improvements result in increased berths and amenities for recreational vessels, improved navigational channels, or opportunities to separate recreational boating from commercial shipping.

Presence of structures: The placement of 957 WTGs and 20 ESPs within the RI and MA Lease Areas in the geographic analysis area would have long-term, adverse impacts on recreational boating and fishing through the risk of allision; risk of gear entanglement, damage, or loss; navigation hazards; space use conflicts; presence of cable infrastructure; and visual impacts. The future offshore wind structures could have beneficial impacts on recreation through fish aggregation and reef effects.

BOEM anticipates that future offshore wind structures would be added intermittently over an assumed 6- to 10-year period, and that these structures would remain until decommissioning of each facility is complete (up to 30 years from installation). A total of 977 structures are anticipated to be constructed within the geographic analysis area for recreation and tourism over the 6- to 10-year period (Figure A.7-9).

The presence of future offshore wind structures would increase the risk of allision or collision with other vessels, and the complexity of navigation within the RI and MA Lease Areas. Generally, the vessels more likely to allide with WTGs or ESPs would be smaller vessels moving within and near wind installations, such as recreational vessels. Future offshore wind development could require adjustment of routes for recreational boaters, anglers, sailboat races, and sightseeing boats.

The adverse impact of the future offshore wind structures on recreational boating would be limited by the distance offshore. The closest WTG could be about 10.6 miles (17.1 kilometers) from shore (a WTG position within Lease Area OCS-A-0486, as viewed from Squibnocket Beach South—Appendix A). A 2012 survey of recreational boaters along the northeastern U.S. coast found that the highest density of recreational vessels routes in the study area was within Nantucket Sound and within 1 nautical mile of the coastline. More than half (52 percent) of recreational boating occurred within 1 nautical mile of the coastline (Starbuck and Lipsky 2013). In 2011, NOAA estimated that 97 percent of the 2011 recreational boating from Massachusetts occurred within 3 nautical miles of shore (BOEM 2012b). Based on these findings, under the No Action Alternative, most recreational vessels would continue to navigate within 3 nautical miles of shore, and thus would not interact with offshore WTGs or ESPs.

Some recreational boating requires traveling farther from shore and therefore would be impacted by the presence of future offshore wind structures. Examples include recreational fishing for HMS, long-distance sailboat races, sightseeing boats, and large sailing vessels. HMS fisheries are further offshore than most fisheries and therefore more likely to overlap with future offshore wind development. Several long-distance sailboat races may pass through the geographic analysis area, depending upon the route selected for a particular year, including the Transatlantic Race, Marion to Bermuda Race, and Newport Bermuda Race. Larger sightseeing boats travel to offshore locations where sighting of whales is more likely. These recreational vessels would need to navigate around future offshore wind projects, or navigate through them while avoiding allisions.

In addition, sailing vessels with masts taller than the lowest elevation of WTG blade tips (for 8-MW WTGs, BOEM assumes that this would be 89 feet [27.1 meters] AMSL) would need to avoid WTGs, and would likely choose to avoid future offshore wind projects altogether. AIS data showed that two sailing vessels with a mast height greater than 89 feet (27.1 meters) AMSL traversed the WDA multiple times in 2016 and 2017 (COP Appendix III-I Epsilon 2018a).

The RI and MA Lease Areas would have an estimated 977 foundations with scour protection and 242 acres (1.0 km^2) of hard protection for inter-array cables, which results in an increased risk of recreational fishing gear loss or damage by entanglement. Export cables are estimated to require 339 acres (1.4 km^2) of cable hard protection, of which a currently unknown proportion would be in the geographic analysis area. The cable protection would also present a hazard for anchoring, as anchors could have difficulty holding or become snagged and lost. Current and likely future offshore wind applicants (including Vineyard Wind) have not proposed to work with USCG to note scour protection or cable hard cover hazards on navigational charts. Updating charts in this way would help make operators of recreational vessels aware of the locations of the cable protection and scour protection. If the hazards are not noted on charts, operators may lose anchors, leading to increased risks associated with drifting vessels that are not securely anchored. Buried offshore cables would not pose a risk for most recreational vessels, as smaller vessel anchors would not penetrate to the target burial depth (6 to 8 feet [1.8 to 2.4 meters]) for the cables. Because anchoring is uncommon in water depths where the No Action Alternative WTGs would be installed, anchoring risk is more likely to be an impact over export cables in shallower water closer to coastlines. The risk to recreational boating would be localized, continuous, and long-term.

Future offshore wind structures could provide new opportunities for offshore tourism by attracting recreational fishing and sightseeing. The wind structures could produce artificial reef effects, attracting species of interest for recreational fishing and resulting in an increase in recreational boaters traveling farther from shore in order to fish within the RI and MA Lease Areas. The structures may also create foraging opportunities for seals, small odontocetes, and sea turtles, attracting recreational boaters and sightseeing vessels. In addition, the future offshore wind projects could attract sightseeing boats for tours. Although the likelihood of recreational vessels visiting the offshore WTG foundations would diminish with distance from shore, increasing numbers of offshore structures may encourage a greater volume of recreational vessels to travel to the WDAs (Appendix A Section A.8.3 and Sections 3.4 and 3.5). Additional fishing and tourism activity generated by the presence of structures could also increase the likelihood of allisions and collisions involving recreational fishing or sightseeing vessels, as well as commercial fishing vessels (Section 3.11).

If approved, the vertical presence of 14-MW WTGs (the tallest WTGs possible under the No Action Alternative) on the offshore horizon would create a visual contrast contrary to the horizontal form of the ocean's water surface and the line at the visual horizon that separates the ocean from sky. The white color of the turbines would also contrast at certain sun angles during the day. The contrast would vary in visual dominance depending on the distance between the viewer and the WTGs, and would be influenced by atmospheric conditions. The visual dominance created by the contrasting elements (form, line, color) would be static as viewed from a given stationary point along the shoreline. Visual dominance created by contrasting elements will vary from offshore locations as floating vessels navigate toward or away from the WTGs.

If the purpose of the viewer's sightseeing excursion is to observe the mass and scale of the WTGs' offshore presence, then the increasing visual dominance would benefit the recreation/tourism experience as the viewer navigates toward the WTGs. However, if experiencing a vast pristine ocean condition is the purpose of the viewer's sightseeing excursion, then the increasing visual dominance may detract from the viewer's recreation/tourism experience.

Studies and surveys that have evaluated the impacts of offshore wind facilities on tourism found that established offshore wind facilities in Europe did not result in decreased tourist numbers, tourist experience, or tourist revenue (Smythe et al. 2018) and that Block Island's WTGs provide excellent sites for fishing and shellfishing (Smythe et al. 2018). A survey-based study found that for prospective offshore wind facilities (based on visual simulations), proximity of WTGs to shore is correlated to the share of respondents who would expect a worsened experience in visiting the coast (Parsons and Firestone 2018).

- At a distance of 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) averaged 8 percent when wind projects were 12.5 miles (20 kilometers) offshore, 6 percent when 15 miles (24.1 kilometers) offshore, and 5 percent when 20 miles (32 kilometers) offshore.
- About 2.6 percent of respondents were more likely to visit a beach with visible offshore wind facilities at any distance.

A 2019 survey of 553 coastal recreation users in New Hampshire included participants in water-based recreation activities such as fishing from shore and boats, motorized and non-motorized boating, beach activities, and surfing at the New Hampshire seacoast (Ferguson et al. 2020). 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 that it would have a neutral impact, and 26 percent an adverse impact (Ferguson et al. 2020).

As described under the IPF for light, the southern shores of Martha's Vineyard and Nantucket located within the viewshed of the WTGs are sparsely developed; however public beaches and tourism attractions in these areas 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), visible WTGs would add a developed/industrial visual element to ocean views that were previously characterized by open ocean, broken only by transient vessels and aircraft passing through the view.

Based on the currently available studies, portions of nearly all 775 WTGs associated with the No Action Alternative (assuming 12- or 14-MW WTGs) could be visible from shorelines (depending on vegetation, topography, weather, and atmospheric conditions), of which up to 34 (fewer than 5 percent) would be within 15 miles (24.1 kilometers) of shore. WTGs visible from some shoreline locations in the geographic analysis area would have adverse impacts on visual resources when discernable due to atmospheric conditions, due to the introduction of industrial elements in previously undeveloped views. Simulations prepared by Vineyard Wind show the anticipated views in clear weather conditions of future offshore wind development at two locations on Martha's Vineyard (Aquinnah Cultural Center and South Beach) and one location on Nantucket (Madaket Beach), omitting the Proposed Action (COP Appendix III-H-a, Epsilon 2020c).[11] As shown in these simulations, the WTGs associated with future offshore wind development would be visible on a clear day, with similar contrast as the Proposed Action WTGs. Atmospheric conditions would limit the number of WTGs discernable during daylight hours for a significant portion of the year (COP Appendix III-H, Section 5.2.2; Epsilon 2020a). When WTGs are discernable from the shore, visual impacts would be more pronounced in views lacking development and outside of heavy recreation use times (i.e., when crowds of beachgoers do not impact the visitor's experience of the natural elements of the landscape). Based on the research cited above on the relationship between visual impacts and impacts on recreational experience, the impact of visible WTGs on recreation would be long-term, continuous, and adverse. Seaside locations on the southern coast of Nantucket and Martha's Vineyard could experience some reduced recreational and tourism activity, but the visible presence of WTGs would be unlikely to impact shore-based recreation and tourism in the geographic analysis area as a whole.

Traffic: Future offshore wind project construction and decommissioning and, to a lesser extent, future offshore wind project operation would generate increased vessel traffic that could inconvenience recreational vessel traffic within the geographic analysis area. The impacts would occur primarily during construction, along routes between ports and the future offshore wind construction areas.

Vessel traffic for each project is not known; however, as an example, the Vineyard Wind 1 Project is projected to generate an average of 7 daily vessel trips between ports and offshore work areas over the entire construction phase, and an average of 18 vessel trips daily during peak construction activity (COP Appendix III-I, Section 5.2.2; Epsilon 2018a). As described in Appendix A, during construction of the No Action Alternative between 2021 and 2030, as many as four future offshore wind projects could be under construction simultaneously (in 2022 or 2023). During such periods, construction of the No Action Alternative would generate an average of 24.1 to 72 vessel trips daily from Atlantic coast ports to worksites within the geographic analysis area, with as many as 184 vessels present (either underway or at anchor) at any given time. Operations and maintenance activities for Vineyard Wind 1 Project are anticipated to generate an average of one to three vessel trips per day between a port and the WDA for observation, with additional vessel trips occurring as needed for repair and maintenance activities. As a result, operation of the No Action Alternative would generate an average of 12 to 36 vessel trips per day.

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 future offshore wind facility is under construction at the same time. Vessel traffic associated with future offshore wind would have long-term, variable, adverse impacts on vessel traffic related to recreation and tourism. Higher volumes during construction would result in greater inconvenience, disruption of the natural marine environment, and risk of collision. Vessel traffic during operations would represent only a modest increase in the background volumes of vessel traffic, with minimal impacts on recreational vessels.

3.10.1.2. Conclusions

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impact on recreation and tourism. BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing impacts on recreation and tourism. Visitors would continue to pursue activities that rely on the area's coastal and ocean environment, scenic qualities, and natural resources.

Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in overall **moderate** adverse impacts, primarily due to noise and vessel traffic during construction and the

[11] These figures are photosimulations prepared by Vineyard Wind and are available at https://www.boem.gov/vineyard-wind-cumulative-visual-assessment.

presence of offshore structures during operations. Noise and vessel traffic would have direct impacts on visitors, who may avoid onshore and offshore noise sources and vessels, and indirect impacts 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 gear entanglement and loss, and visual impacts from offshore structures, although few WTGs would be within 15 miles (24.1 kilometers) of shore (the point at which adverse impacts on tourism may outweigh beneficial impacts).

BOEM also anticipates that the impacts associated with future offshore wind activities in the analysis area would result in overall **minor beneficial** impacts due to the presence of offshore structures and cable hard cover, which could provide opportunities for fishing and sightseeing.

3.10.2. Proposed Action and Action Alternatives

3.10.2.1. Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on recreation and tourism were described in Draft EIS Section 3.4.1.3, and additional information is included in Table 3.14-1. Changes to the design capacity of the wind turbines proposed in the Vineyard Wind COP (Epsilon 2020a), compared to the turbines evaluated in the Draft EIS, would alter the maximum-case scenario for the Proposed Action and all other action alternatives. If Vineyard Wind were to install 57 14-MW WTGs instead of the potential 100 8-MW WTGs initially evaluated, the maximum height of the blade tip for 14-MW WTGs would be 837 feet (255 meters) above the surface, compared to 696 feet (212 meters) for the 8-MW WTGs. The nacelle height of the 14-MW WTGs would be 495 feet (150.9 meters) above the surface, compared to 397 feet (121 meters) for the 8-MW WTGs. Because the WTGs would exceed 699 feet (213 meters), FAA regulations require additional mid-tower lighting, in addition to lighting at the top of the nacelle (FAA 2015). The taller WTGs and additional lighting would be visible from additional locations within the geographic analysis area. As a result, the maximum-case scenario for recreation and tourism differs depending on the specific topic:

- The 14 MW WTG option represents the maximum-case scenario for visual impacts. Although this option requires only 57 WTGs, the taller WTGs would be visible from more coastal locations than the smaller, 8-MW WTGs.
- The 8-MW WTG option represents the maximum-case scenario for recreational fishing and boating, due to the need for 100 WTGs, with resulting increase in navigational complexity, as compared to the 57 structures needed if 14-MW WTGs are used.

Increasing the size of the proposed substation by 2.2 acres (less than 0.1 km^2), as described in Chapter 2, would not change the analysis of impacts on recreation and tourism for the Proposed Action and all other action alternatives because (Section 3.12.2.1), the expanded substation area would be within a designated industrial area.

The Proposed Action would have long-term, **minor**, impacts on recreation and tourism in the geographic analysis area, due to the visual impact of the 57 WTGs from coastal locations and the greater navigational risks for recreational vessels within the WDA. The Proposed Action would have long-term, **minor beneficial** impacts due to the fish aggregation and habitat conversion impacts of the WTGs and ESPs, resulting in new fishing and sightseeing opportunities. The Proposed Action would have short-term, **minor** to **moderate**, impacts during construction due to the temporary impacts of noise and vessel traffic on recreational vessel traffic, the natural environment, and species important for recreational fishing and sightseeing. Selection of the New Hampshire Avenue cable landfall site and associated OECC route through Lewis Bay would result in **moderate** (instead of **minor**) impacts due to vessel traffic, noise from construction and the impacts of anchoring, specifically in and near Lewis Bay, which supports substantial marine recreation and tourism activity.

The cumulative impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are listed by IPF in Table 3.14-1. The most impactful beneficial IPFs would include the presence of future offshore wind structures that could attract fish, invertebrates, and marine mammals, while the most impactful IPFs would include temporary construction noise and the presence of offshore structures.

The nature of the IPFs affecting recreation and tourism for cumulative impacts, including the Proposed Action, would be of the same types described in Sections 3.10.1.1 and 3.10.1.2, but may differ in intensity and extent. If the Vineyard Wind 1 Project is not approved, it is assumed that the energy demand that the Vineyard Wind 1 Project would have filled would likely be met by other projects in remaining areas of the Massachusetts, Rhode Island, and/or New York leases. Although the impacts from a substitute project may differ in location and time, depending on where and when future offshore wind facilities are built to meet the remaining demand, the nature of impacts and the total number of WTGs would be similar either with or without the Proposed Action, as described in Section 3.10.1 In other words, future offshore wind facilities capable of generating 9,404 MW (32.1 trillion Btu) would be built in the RI and MA Lease Areas, although, in the absence of the Proposed Action, none would be built before 2021. Therefore, the cumulative impacts related to WTGs would be equal to those described in Section 3.10.1.1. The remainder of this subsection focuses on potential incremental impacts of the Proposed Action that would differ in intensity and/or extent from the No Action Alternative impacts described in Sections 3.10.1.1 and 3.10.1.2.

Anchoring: Anchoring by Proposed Action construction and maintenance vessels would contribute to disturbance of marine species and inconvenience to recreational vessels that must navigate around the anchored vessels. The Proposed Action would deploy four to six vessels along sections of the OECC during cable installation activities (COP Volume III, Section 7.8.2.1.2 and Appendix III-I; Epsilon 2018a). During the construction phase, an average of 25 vessels (up to 46 vessels during the period of maximum activity) would be present in the WDA or OECC at any one time. Most anchored vessels would be within a work area safety zone. The impacts of anchoring on recreational activities would be greater if the New Hampshire Avenue landfall site is selected, resulting in vessel anchoring and benthic disturbance within the heavily traveled Lewis Bay.

Vessel anchoring for construction of the Proposed Action would have direct and indirect, localized, short-term, **minor** impacts on tourism and recreation due to the need to navigate around vessels and work areas and the disturbance of species important to recreational fishing (Section 3.4.2). The impacts would be **moderate** within Lewis Bay if the New Hampshire Avenue landfall site is selected. (Although anchoring is not specifically addressed in this context in the Draft EIS, anchoring is a part of the evaluation of construction vessel traffic on recreation and tourism in Draft EIS Section 3.4.4.3). Cumulatively, the Proposed Action, in combination with past, present, and reasonably foreseeable activities would have direct and indirect, localized, short-term, **minor** to **moderate** impacts on recreation and tourism during the period in which offshore wind projects are being constructed in the geographic analysis area. A greater number of vessels would be anchored in the cumulative scenario, across the entire RI and MA Lease Areas, potentially resulting in **moderate** impacts regardless of whether the Lewis Bay cable route is used.

Light: When nighttime construction occurs, the vessel lighting for vessels traveling to and working at the proposed Project's offshore construction areas may be visible from onshore locations depending upon the distance from shore, vessel height, and atmospheric conditions. Visibility would be sporadic and variable.

The Proposed Action would have a discrete, incremental contribution to nighttime visibility of the WTGs due to required aviation hazard lighting. Hazard lighting from all of the Proposed Action's WTGs could be visible up to 35 miles (56 kilometers) away from some south-facing coastlines and elevated locations on Martha's Vineyard, Nantucket, and possibly Cape Cod, depending on vegetation, topography, weather, and atmospheric conditions. Vineyard Wind has committed to voluntarily implement ADLS (as described in Draft EIS Section 3.4.1.3) as a voluntary measure that would activate the Proposed Action's WTG lighting when aircraft approach the Vineyard Wind 1 Project WTGs, which is expected to occur less than 0.1 percent of annual nighttime hours. During other times (and during ADLS activation in weather or atmospheric conditions when WTG lighting is not visible from shore), the warning lighting would not be visible, and would thus not impact recreation and tourism. As noted in Section 3.10.1.1, during times when the Proposed Action's aviation warning lighting is visible, this lighting would add a developed/industrial visual element to views that were previously characterized by dark, open ocean. Due to the limited duration and frequency of such events and the distance of the Proposed Action's WTGs from shore, visible aviation hazard lighting for the Proposed Action would, result in a long-term, intermittent, **negligible** impact on recreation and tourism.

Cumulatively, aviation hazard lighting from 652 additional WTGs (709 total WTGs, including the Proposed Action [of the 775 WTGs within the analysis area]) could potentially be visible within the geographic analysis area. As described in Section 3.10.1.1, without use of ADLS, lighting from future offshore wind projects other than the Proposed Action would include red flashing lights on top of WTG nacelles and at the midpoint of WTG towers. Lighting from the Proposed Action, in combination with past, present, and reasonably foreseeable activities, would have a long-term **minor** impact on recreation and tourism. This cumulative impact would be reduced to **negligible** magnitude if ADLS is implemented on all other offshore wind projects.

New cable emplacement and maintenance: The Proposed Action would have a discrete, incremental contribution to offshore cable emplacement due to the location of the Proposed Action OECC across Nantucket Sound and possibly through Lewis Bay, where impacts would be greater, as explained in Draft EIS Section 3.4.4.3. Recreational vessels traveling near the route of the OECC would experience localized, temporary, impacts during construction due to the need to navigate around cable installation work areas. Cable installation could also affect fish and mammals of interest for recreational fishing and sightseeing through dredging and turbulence, although species would recover upon completion (Sections 3.4.2.1 and 3.5.2.1). Installation and maintenance of the Proposed Action's cables would have localized, short-term, **minor** impacts on recreation and tourism, except that the New Hampshire Avenue landfall site would have a localized, short-term, **moderate** impact.

Specific cable locations associated with future offshore wind projects have not been identified within the geographic analysis area with the exception of the Vineyard Wind 2 Project cable, which would use the same offshore cable corridor as the Proposed Action. The Equinor, Mayflower, and Bay Wind offshore wind project cables would cross the geographic analysis area. Based on the cumulative assumptions in Appendix A, cables would not be installed concurrently with the Proposed Action, except for the South Fork Wind project. Based on the extended period of time during which cables would be installed within the geographic analysis area and the temporal overlap of the Proposed Action with the South Fork Wind project, cable emplacement and maintenance for the Proposed Action, in combination with past, present, and reasonably foreseeable activities would have a short-term **minor** to **moderate** impact on recreation and tourism (regardless of whether the Lewis Bay cable route is used).

Noise: Noise from operations and maintenance, pile driving and trenching, and vessels could result in direct and indirect impacts on recreation and tourism. Indirect, temporary impacts on recreation and tourism would result from the impact within the WDA and along the OECC route on species important to recreational fishing and sightseeing. Offshore construction noise and onshore cable installation near the landfall area would have direct impacts on the recreational enjoyment of the marine and coastal environments. Onshore sites include Covell's Beach or Englewood Beach and nearby areas, depending upon the landfall site selected. As stated in the Draft EIS, noise from Proposed Action construction would have direct and indirect, localized, short-term, **minor** to **moderate** impacts on recreation and tourism.

Onshore or offshore operational noise from the substation or WTGs would be similar to the noise described for other projects under the No Action Alternative, and would thus have continuous, long-term, **negligible** impacts.

As stated in Table A-4 in Appendix A, pile driving for the South Fork Wind Project would overlap Proposed Action construction for approximately 2 weeks, and future offshore wind surveying and construction would generate successive periods of intermittent offshore noise. Due to the potential for noise generated by concurrent and successive activity within the geographic analysis area, noise from construction of the Proposed Action, in combination with past, present, and reasonably foreseeable activities, would have localized, short-term, **minor** to **moderate** impacts on recreation and tourism, while noise from operation would have a continuous, long-term, **negligible** impact.

Port utilization: The geographic analysis area for recreation and tourism contains no ports anticipated to be used for staging and construction support or operations support for offshore wind. The Proposed Action would have a discrete, incremental impact on

Vineyard Haven Harbor, which would be used for operational support, but the increase in marine traffic within the harbor is not anticipated to affect recreational boating. The Proposed Action would have a long-term, negligible, impact on recreation and tourism due to port utilization within the geographic analysis area. No other offshore wind projects are known to have plans to use Vineyard Haven Harbor for operational support, although such use is possible. Accordingly, the Proposed Action, in combination with past, present, and reasonably foreseeable activities, would have a long-term negligible impact on recreation and tourism due to port utilization within the geographic analysis area.

Presence of structures: The Proposed Action's 100 WTGs and 2 ESPs would impact recreation and tourism through increased navigational complexity and risk of allision or collision within the WDA; the attraction of recreational vessels to future offshore wind structures for fishing and sightseeing; the adjustment of vessel routes used for activities such as sailboat races, 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 (Section 3.10.1.1).

As explained in more detail in Section 3.10.1.1, the Proposed Action's WTGs and ESPs could attract recreational vessels. Although the likelihood of recreational vessels visiting the offshore WTG foundations would diminish with distance from shore, the fish aggregation and reef effects of the Proposed Action could increase recreational fishing within the WDA and create foraging opportunities for seals, small odontocetes, and sea turtles, attracting recreational boaters and sightseeing vessels. In addition, future offshore wind development could attract sightseeing boats offering tours of the wind facilities.

Based on the impacts of the WTGs and ESPs on navigation, the potential reef effects of these structures, and the risks to anchoring and gear loss associated with scour or cable protection (other than impacts on visual resources, which are discussed below), the Proposed Action would have long-term, continuous, minor beneficial and minor impacts on recreation and tourism. This impact rating was revised from Draft EIS Section 3.4.4.3 (which found that the beneficial and adverse impacts would be negligible), based upon comments from recreational fishing practitioners. Cumulatively, the Proposed Action, in combination with past, present, and reasonably foreseeable activities, is anticipated to have long-term, minor beneficial impacts due to areas with hard-cover protection over cables and minor to major impacts on recreation and tourism due to the increased number of offshore structures and reduction of search and rescue (SAR) capacity, as discussed in Section 3.13.2.

As described in Section 3.10.1.1, the southern shores of Martha's Vineyard and Nantucket located within the viewshed of the WTGs are sparsely developed but highly visited. When visible (i.e., on clear days in locations with unobstructed ocean views), the Proposed Action's 57 14-MW WTGs (the tallest WTGs considered for the Proposed Action) would add a developed/industrial visual element to ocean views that were previously characterized by open ocean, broken only by transient vessels and aircraft passing through the view. The primary impacts on visual resources would occur due to the contrast between the existing unobstructed sea views and the industrial-appearing WTGs to be constructed under the Proposed Action. Simulations prepared by Vineyard Wind show the anticipated views of the Proposed Action in clear weather conditions at the Aquinnah Cultural Center, South Beach, and Madaket Beach (COP Appendix III-H-a; Epsilon 2020c).[11] As shown, the WTGs associated with other future offshore wind development would be visible on a clear day, with the color and irregular forms of the WTGs contrasting with the existing uninterrupted horizontal horizon line associated with the open ocean. In locations that are highly sensitive to such contrast (such as undeveloped beach areas with no visible signs of human activity), impacts of the Proposed Action on visual resources alone could range from minor to moderate or possibly major depending on weather conditions and how many WTGs are discernable on any given day.

The visual impact of future offshore wind structures could directly and indirectly impact recreation and tourism. The visual contrast created by the WTGs could have a beneficial, adverse, or neutral impact on the quality of the recreation and tourism experience depending on the viewer's orientation, activity, and purpose for visiting the area. Some of the limited available research on the link between visual impacts of future offshore wind, and resultant impacts on recreation and tourism, is summarized in Section 3.10.1.1 and Draft EIS Section 3.4.4.3. Under the 14 MW scenario, nearly all coastal public viewpoints would be more than 15 miles (24.1 kilometers) from the closest WTGs. Portions of all of the Proposed Action's WTGs (and possibly both ESPs) could potentially be visible from coastal and elevated inland locations on Martha's Vineyard, Nantucket, and mainland Cape Cod, depending upon vegetation, topography, and atmospheric conditions. Research described in Section 3.10.1.1 suggests that at a distance of 15 miles (24.1 kilometers), only 6 percent of beach visitors would select a different beach based on the presence of future offshore wind turbines. As many as 10 of the Proposed Action's 57 WTGs would be within 15 miles (24.1 kilometers) of the coast of Martha's Vineyard, while 15 would be within 15 miles (24.1 kilometers) of the coast of Nantucket. Considering these factors, BOEM expects the impact of visible WTGs on the use and enjoyment of recreation and tourist facilities and activities during operations and maintenance of the Proposed Action to be long-term, continuous, and minor. While some visitors to south-facing coastal or elevated locations may alter their behavior, this changed behavior is unlikely to meaningfully affect the recreation and tourism industry as a whole (Section 3.7.2).

Under the No Action Alternative, portions of up to 717 WTGs from future offshore wind projects other than the Proposed Action could potentially be visible from coastal locations (again, depending on vegetation, topography, weather, and atmospheric conditions, and assuming the use of 12- or 14-MW WTGs). Cumulatively, portions of 775 WTGs from the Proposed Action combined with past, present, and reasonably foreseeable activities could potentially be visible from coastal and elevated locations in the geographic analysis area, including up to 34 (fewer than 5 percent of the total) that would be within 15 miles (24.1 kilometers) of shore. The simulations prepared by Vineyard Wind show the anticipated cumulative views in clear conditions of future offshore wind projects associated with the No Action Alternative and the Proposed Acton at two locations on Martha's Vineyard (Aquinnah Cultural Center, and South Beach) and one location on Nantucket (Madaket Beach) (COP Appendix III-H-a;, Epsilon 2020c).[11] As shown, the WTGs would be discernable on a clear day, with the color and irregular forms of the WTGs contrasting with the existing uninterrupted horizontal horizon line associated with the open ocean. As shown in the simulations, the Proposed Action WTGs would contribute approximately equally to visual impacts from South Beach and Madaket Beach, locations where the Proposed Action WTGs are closest to that particular viewpoint. The Proposed Action would be visually subordinate to future offshore wind projects from the Aquinnah Cultural Center due to distance and topographic screening. Atmospheric conditions would limit the number of cumulative

WTGs discernable during daylight hours for a significant portion of the year (COP Appendix III-H, Section 5.2.2; Epsilon 2020a). Due to the contrast of these industrial-appearing structures with the primarily undeveloped landscape of these shoreline areas, the Proposed Action, in combination with past, present, and reasonably foreseeable activities, would have continuous, long-term, **minor** impacts on recreation and tourism in the overall geographic analysis area, with **moderate** impacts on south-facing shoreline areas of Martha's Vineyard, Nantucket, and Cape Cod with views of WTGs. However, impacts would be reduced when atmospheric conditions limit the number of WTGs discernable from any one viewing location.

Traffic: The Proposed Action would contribute to increased vessel traffic and associated vessel collision risk, primarily during project construction and decommissioning, along routes between ports and the offshore construction areas. As detailed in Draft EIS Section 3.4.4.3, construction could result in a maximum of up to 46 trips in a single day traveling from ports to the WDA (COP Appendix III-I, Section 5.2.2; Epsilon 2018a). The Proposed Action would generate an average of 7 daily vessel trips during the entire construction period and during peak construction periods would generate an average of 18 daily vessel trips to and from ports in Massachusetts, Rhode Island, and other locations. Construction would result in an average of 25 and a maximum of 46 vessels present at offshore work areas. Recreational vessels may experience delays within the ports serving the construction (outside the geographic analysis area), but most recreational boaters in the geographic analysis area would experience only minor inconvenience from construction-related vessel traffic. Vessel travel requiring a specific route that crosses or approaches the OECC, especially within Lewis Bay (if the New Hampshire Avenue landfall site is selected), could potentially experience **moderate** impacts. Operation of the Proposed Action would generate one to three daily vessel trips. Accordingly, the increased vessel traffic and risk of collision from Proposed Action construction would have direct, short-term, variable, and **minor** impacts on recreation and tourism during construction (**moderate** in Lewis Bay if the New Hampshire Avenue landfall site is selected) and localized, intermittent, long-term, **negligible** impacts during operations.

The Proposed Action is anticipated to be under construction concurrently with only one other project (South Fork). Construction of these two offshore wind projects would increase the traffic generated between the ports and the RI and MA Lease Areas or cable installation 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. As a result, the Proposed Action, in combination with past, present, and reasonably foreseeable activities, would have a short-term, variable, and **minor** impact on recreation and tourism during construction (**moderate** in Lewis Bay if the New Hampshire Avenue landfall site is selected) and a long-term, intermittent, localized, and **negligible** impact during operations.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from **negligible** to **moderate** impacts and **negligible** to **minor beneficial** impacts. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in **moderate** impacts and **minor beneficial** impacts on recreation and tourism in the geographic analysis area. The main drivers for the impact ratings include the long-term, **moderate** impacts and **minor beneficial** cumulative impacts associated with the presence of offshore structures and cable hard cover, as discussed in Section 3.10.2.1. The Proposed Action would contribute to the overall impact rating primarily through the same IPFs. While long-term impacts are the main drivers, the overall moderate impacts are also indicated by the short-term, minor to moderate impacts during construction from anchoring, cable emplacement, noise, and vessel traffic. **Moderate** impacts include both direct and indirect impacts on marine recreational activities and indirect impacts on recreation and tourism in portions of the geographic analysis area resulting from the visual impact of WTGs. The **minor beneficial** cumulative impacts would result from a small and measurable benefit from the opportunities provided by future offshore wind structures for tours and recreational fishing.

3.10.2.2. Cumulative Impacts of Alternatives B, C, D1, D2, and E

The direct and indirect impacts of Alternatives B, C, D1, D2, and E on recreation and tourism are described in Draft EIS Sections 3.4.4.4 through 3.4.4.7. These impacts were revised to reflect the potential use of 14-MW WTGs:

- The difference between Alternative B and the Proposed Action is the selection of Covell's Beach as the landfall site and the resultant avoidance of impacts on recreation and tourism activity in and near Lewis Bay, including high volumes of marine recreational traffic and ferry services, which support tourism. Alternative B would also eliminate impacts on Englewood Beach and residences near the New Hampshire Avenue cable landfall site, some of which may be intended for rental activity. In other respects, the direct and indirect impacts of Alternative B on recreation and tourism would be the same as those of the Proposed Action.
- Alternative C would relocate the six northernmost WTG locations to the southern portion of the WDA, which would provide more unobstructed space for navigation in the northern portion of the WDA, closer to ports and other shore facilities commonly used by recreational vessels. Moving WTGs away from the northern portion of the WDA would also reduce visual impacts on land-based recreation areas by moving the closest WTGs beyond 15 miles (24.1 kilometers) from the closest shore-based viewers, and reducing the portion of the proposed Project's WTGs that could be visible to land-based observers. In other respects, the impacts of Alternative C on recreation and tourism would be the same as those of the Proposed Action.
- Alternative D (including Alternatives D1 and D2) would result in different WTG configurations, establish wider spacing of WTGs, and require a larger WDA. The wider spacing would improve maneuverability for recreational vessels, and the grid pattern of Alternatives D1 and D2 would allow for easier course plotting through the WDA. However, the larger overall WDA would increase the marine area affected by future offshore wind structures. On balance, Alternatives D1 and D2 would enhance navigation through the WDA but would remain similar in overall impact on recreation and tourism.
- Alternative E would involve construction of 84 WTGs, each with generation capacity of 9 to 10 MW. Alternative E would result in fewer structures and wider spacing between structures and/or a potentially smaller footprint for the WDA compared to the 100-turbine scenario for the Proposed Action. Conversely, Alternative E would require more offshore structures than the 57-turbine scenario for the Proposed Action (if 14 MW turbines are used). Generally, fewer turbines would decrease the impacts

on offshore recreation activity compared to the proposed Project, but would not change the overall impact magnitudes described for the Proposed Action in Section 3.10.2.1. However, as noted in the beginning of Section 3.10.2.1, the 14 MW turbines would have a greater visual impact. Overall, construction, installation, and decommissioning of Alternative E would have impacts on recreation and tourism similar to those for the Proposed Action.

Accordingly, the direct and indirect impacts resulting from individual IPFs associated with Alternatives B, C, D1, D2, and E on recreation and tourism would be similar to those of the Proposed Action: **negligible** to **moderate** impacts due to the IPFs discussed above, and **negligible** to **minor beneficial** impacts (due to new offshore recreational opportunities).

The cumulative impacts resulting from individual IPFs associated with each alternative, when combined with past, present, and reasonably foreseeable activities, would be very similar to those of the Proposed Action: **negligible** to **major** impacts on recreation and tourism, along with **negligible** to **minor beneficial** impacts due to opportunities for new recreation activity. This is because the majority of the cumulative impacts come from future offshore wind projects, and the impacts of each alternative would be very similar to those of the Proposed Action.

The overall cumulative impacts of each alternative on recreation and tourism within the geographic analysis area, when combined with past, present, and reasonably foreseeable activities, would be of the same level as under the Proposed Action—**moderate** and **minor beneficial**. The impact rating is primarily driven by impacts from the long-term presence of offshore structures and short-term anchoring, cable emplacement, noise, and vessel traffic.

3.10.2.3. Direct, Indirect, and Cumulative Impacts of Alternative F

Alternative F analyzes a vessel transit lane through the WDA, in which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. Under this alternative, BOEM is analyzing a 2- and 4-nautical-mile northwest/southeast vessel transit lane through the WDA combined with any action alternative; however, this analysis focuses on the combination of Alternative F with either the Proposed Action or Alternative D2 layout. The northern transit lane within the WDA could result in the relocation of 16 to 34 WTG placements and a 12 to 61 percent increase in the size of the WDA and extent of inter-array cables (depending on whether the Proposed Action or Alternative D2 layout is used).

The direct and indirect impacts of Alternative F on recreation and tourism would be similar to the Proposed Action. Alternative F would increase both the adverse and beneficial impacts on recreation and tourism as itemized below.

- The transit lane could benefit some recreational vessels in travelling through the WDA; however, the transit lane direction is oriented to assist common commercial fishing transit routes, and its orientation would not necessarily provide a useful route for all recreational vessels passing through the area.
- Because of the ease of navigating within the transit lane, recreational fishing vessels attracted by fish aggregation effects of the WTGs could flank the sides of the structures within the transit lane. Although there is some uncertainty about how traffic and anglers would behave, flanking these areas could lead to increased vessel congestion, space conflict, and navigational risk.
- The transit lane could be used as a location for both recreational and commercial fishing, in addition to funneling traffic through the WDA. This funneling effect would increase the potential for allision, collision, and other navigation conflicts for recreational and other vessels. This effect would be stronger with the Proposed Action layout than the Alternative D2 layout, due to the narrower WTG spacing in the Proposed Action (0.7 nautical mile, compared to 1 nautical mile in Alternative D2) WTG spacing.
- Alternative F would increase the extent of the WDA as noted above. As described in Section 3.10.1, about 97 percent of recreational vessels stay within 3 miles (5 kilometers) of shore. Those that travel as far from shore as the Proposed Action, such as HMS fishing vessels, sailboat races, and sightseeing tours, would have a larger WDA to avoid or navigate through.
- The increase in inter-array cabling could result in a greater number of areas with hard cover protection for cables, with the risk of gear entanglement or loss. Vineyard Wind estimates that hard cover protection would be require for approximately 10 percent of inter-array cable distance. Alternative F would require 221 miles (355 kilometers) of inter-array cabling if applied in concert with the Proposed Action layout and 228 miles (376 kilometers) if applied in concert with the Alternative D2 layout. By comparison, the Proposed Action without Alternative F would require 177 miles (284.8 kilometers) of inter-array cables, while Alternative D2 would require approximately 186 miles (300 kilometers).

The benefit of the transit lane to recreational vessels is balanced by the inconvenience resulting from a larger WDA, potential navigational conflicts resulting from use of the transit lane, and greater extent of cabling with hard cover protection. As a result, the direct and indirect impacts resulting from individual IPFs associated with Alternative F on recreation and tourism, regardless of underlying WTG layout would remain **negligible** to **moderate**, along with **negligible** to **minor beneficial** impacts due to new recreation activity.

The cumulative impacts resulting from individual IPFs associated with Alternative F, when combined with past, present, and reasonably foreseeable projects, would be very similar to those of the Proposed Action, **negligible** to **major** impacts on recreation and tourism, along with **negligible** to **minor beneficial** impacts due to new recreation activity. The majority of the cumulative impacts of any alternative come from future offshore wind projects, and the incremental impacts of this alternative would be very similar to those of the Proposed Action.

The overall cumulative impacts of Alternative F on recreation and tourism within the geographic analysis area when combined with past, present, and reasonably foreseeable activities would have **moderate** impacts and **minor beneficial** impacts. The impact ratings are primarily driven by impacts from the long-term presence of offshore structures and short-term anchoring, cable emplacement, noise, and vessel traffic.

BOEM has qualitatively evaluated the cumulative impacts of implementing all six RODA-recommended transit lanes, including the northern transit lane described for Alternative F, as well as five other transit lanes through the RI and MA Lease Areas. To the extent additional transit lanes are implemented in the future outside the WDA as part of RODA's suggestion, the WTGs for future offshore wind projects may need to be located farther from shore, similar to the proposed Project under Alternative F. As a result, establishment of these additional transit lanes could require longer vessel trips for all phases of future projects and longer timeframes for cable installation. Collectively, these effects would result in greater impacts on recreation and tourism overall than if Alternative F were not implemented, due to increased vessel congestion, space conflict, and navigational risk within and along the transit lanes; larger combined Lease Areas to navigate through; and increased gear entanglement and loss due to increased hard-cover area.

3.10.2.4. Comparison of Alternatives

The Proposed Action would result in direct and indirect impacts resulting from individual IPFs, localized to regional, short-term to long-term, negligible to moderate impacts on recreation and tourism due to anchoring, light, cable emplacement and maintenance, noise, the presence of structures (including visual impacts), and vessel traffic and collisions. The Proposed Action would also have direct and indirect, localized, long-term, negligible to minor beneficial impacts from fish aggregation and reef effects and the possibility of new vessel tours of the project. Port utilization would contribute to adverse impacts (i.e., during heavy periods of use, dredging, and maintenance) and beneficial impacts (i.e., as a result of improvements).

As discussed in Draft EIS Section 3.4.4.9, the direct and indirect incremental impacts associated with the Proposed Action on recreation and tourism do not change substantially Alternatives B through E. Alternative B would avoid the impacts on recreation and tourism in Lewis Bay by eliminating the New Hampshire Avenue cable landfall site. All of the alternatives that incorporate WTGs with capacities between 8 and 10 MW would have a reduced adverse visual impact compared to the proposed 14 MW WTG option, due to shorter tower heights and less required lighting, but they would have a greater impact on recreational boating, due to the greater number of offshore structures necessary. The incremental direct and indirect impacts of Alternative F, with either the Proposed Action or Alternative D2 WTG layout, would also be similar to each other and to other action alternatives and the Proposed Action. As a result, all alternatives would have direct and indirect impacts resulting from individual IPFs of negligible to major impacts on recreation and tourism, as explained under the individual IPFs in Section 3.10.2.1, along with negligible to minor beneficial impacts due to new recreation activity.

The IPFs of the Proposed Action, when combined with past, present, and reasonably foreseeable activities, could result in cumulative impacts whenever activities occur within the water quality geographic analysis area or overlap in time. Cumulative impacts under any action alternative would likely be very similar because the majority of the cumulative impacts of any alternative come from other future offshore wind development, which does not change between alternatives. As a result, the cumulative impacts resulting from individual IPFs associated with any action alternative when combined with past, present, and reasonably foreseeable activities would have in direct and indirect, localized to regional, short term to long-term, negligible to major impacts on recreation and tourism due to anchoring, light, cable emplacement and maintenance, noise, the presence of structures (including visual impacts), and vessel traffic and collisions. The Proposed Action would also have direct and indirect, localized, long-term, negligible to minor beneficial impacts from fish aggregation and reef effects and the possibility of new vessel tours of the Project.

In conclusion, the overall cumulative impacts on recreation and tourism from any action alternative, when combined with past, present, and reasonably foreseeable activities, would be moderate impacts and minor beneficial. The impact rating is primarily driven by impacts from the long-term presence of offshore structures and short-term anchoring, cable emplacement, noise, and vessel traffic.

3.11. COMMERCIAL FISHERIES AND FOR-HIRE RECREATIONAL FISHING

3.11.1. No Action Alternative Impacts

Table 3.11-1 contains a detailed summary of baseline conditions and the impacts of ongoing and future offshore activities other than offshore wind on commercial fisheries and for-hire recreational fishing, based on the IPFs assessed. Section 3.10 provides analysis of private recreational fishing impacts. This information comes primarily from the Draft EIS, supplemented by additional information from NOAA, other fisheries management bodies, and other sources consulted in the course of responding to comments on the Draft EIS. The impact analysis is limited to impacts within the geographic analysis area for commercial fisheries and for-hire recreational fishing as described in Table A-1 and shown on Figure A.7-10, Appendix A. Specifically, this includes the boundaries of the management area of the New England Fishery Management Council and of the Mid-Atlantic Fishery Management Council for all federal fisheries within the U.S. Exclusive Economic Zone (from 3 to 200 nautical miles from the coastline) through Cape Hatteras, North Carolina, plus the state waters of the Commonwealth of Massachusetts (from 0 to 3 nautical miles from the coastline).

Commercial fisheries in the northeast United States are known for the large landings of herring, menhaden, clam, squid, scallop, skates, and lobster, and for being a notable source of profit from scallop, lobster, clam, squid, and other species (NOAA 2019d). Commercial fisheries obtained the greatest concentration of revenue from around the 164-foot (50-meter) contour off Long Island and George's Bank. There were over 4,300 federally permitted fishing vessels in the Northeast in 2017, landing fish in several major northeast ports (Table 3.11-2).

Commercial fisheries and for-hire recreational fishing in the geographic analysis area are subject to pressure from ongoing activities, including regulated fishing effort, vessel traffic, and climate change. Fisheries management impacts commercial fisheries and for-hire recreational fishing in the region through management of sustainable fish stocks and measures to reduce impacts on important habitat and protected species. These management plans include measures such as fishing seasons, quotas, and closed areas, which constrain how the fisheries are able to operate and adapt to change. These management actions can reduce or increase the size of available landings to commercial and for-hire recreational fisheries. Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the North Atlantic right whale by 60 percent (McCreary and Brooks 2019). This, along with Area 3 trap cap reductions, will likely have considerable impact on fishing effort in the lobster and Jonah crab fisheries in the geographic analysis area. The "Baseline Conditions" in Table 3.11-1 includes additional details on specific future fishery management actions that would impact commercial fisheries and for-hire recreational fishing.

Climate change is also predicted to affect Northeast fishery species (Hare et al. 2016), which will impact commercial and for-hire fisheries differently depending on the targeted species. Changing environmental and ocean conditions (currents, water temperature, etc.), increased magnitude or frequency of storms, and shoreline changes can impact fish distribution, populations, and availability to commercial and for-hire recreational fisheries. Refer to Section 3.4 as well as Table 3.4-1 for details on fish impacts. Impacts from other ongoing activities, including structures such as existing cables and pipelines, have been largely mitigated through burial of the infrastructure.

Under the No Action Alternative, the proposed Project would not be built and hence would have no impact on commercial fisheries and for-hire recreational fishing. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. If the Vineyard Wind 1 Project is not approved, then impacts from the proposed Project would not occur as proposed. However, the state demand that the Vineyard Wind 1 Project would have filled, if approved, could likely be met by other projects in the geographic analysis area for this resource. Therefore, the impacts on this resource would be similar, but the exact impact 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 and considers the assumptions included in Section 1.2 and Appendix A. A detailed analysis of impacts associated with future offshore wind development is provided Section 3.11.1.1 and summarized in Table 3.11-1. Cumulative impacts of the Proposed Action and action alternatives are analyzed in Section 3.11.2.

3.11.1.1. Future Offshore Wind Activities (without Proposed Action)

BOEM expects these future offshore wind development activities to affect commercial fisheries and for-hire recreational fishing through the following primary IPFs.

Anchoring: Anchoring could pose a localized (within a few hundred meters of anchored vessels), temporary (hours to days), navigational hazard to fishing vessels. In the cumulative scenario, there would be increased vessel anchoring during survey activities and during the construction and installation of offshore components as a result of future offshore wind activities over the next 10 years. However, the location and level of these impacts would depend on specific locations and duration of activity. As specified in Table A-4 in Appendix A, BOEM assumes that anchoring disturbance for each offshore wind project, other than the Proposed Action, would be equal to 0.10 acre per mile of offshore export cable. If future projects utilize dynamic positioning vessels, these effects could be less. Up to 276 acres (1.1 km^2) of seafloor could be disturbed out of the over 200 million acres within the geographic analysis area as a result use of anchoring during construction activities over the next 10 years. In addition, there could be increased anchoring associated with the installation of met towers or buoys. Anchoring impacts on finfish, invertebrates, and EFH are discussed in Section 3.4.1.1, and impacts on navigation and vessel traffic are discussed in Section 3.13.1.1.

New cable emplacement and maintenance activities: This IPF could cause localized, short-term impacts including disrupting fishing activities during active installation and maintenance or periods during which the cable is exposed on the seabed prior to burial (if simultaneous lay and burial techniques are not used). Fishing vessels may not have access to impacted areas, which could lead to reduced revenue and/or increased conflict over other fishing grounds. Assuming future projects use installation procedures similar to those proposed in the Vineyard Wind COP, the duration (one day to several months) and extent (several meters to 500 meters during active procedures) of impacts would include temporary displacement of fishing vessels and disruption of fishing activities in the estimated total area of disturbance up to 8,153 acres (33 km^2), which is the assumed total area of seafloor disturbed over the next 10 years as a result of offshore export and inter-array cable emplacements for offshore wind facilities using the assumptions in Table A-4 in Appendix A. BOEM anticipates that there will likely be simultaneous cable-laying activities based on the estimated construction timeline. While simultaneous cable-laying activities may disrupt fishing activities 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. BOEM does not anticipate differential impacts on fishery resources based on whether cable-laying activities occur sequentially or concurrently. However, both fishing and fishery resources may be differentially impacted based on the season in which the activities occur. It is anticipated that most construction activities would take place in the summer due to more favorable weather conditions. Thus fisheries and fishery resources most active in the summer will likely be impacted more than those in the winter. Table 3.4-1 includes impacts on finfish and invertebrates.

Noise: Noise from construction, site assessment G&G survey activities, operations and maintenance, pile driving, trenching, and vessels could cause localized, temporary impacts on commercial fisheries and for-hire recreational fishing. The most impactful noises on commercial fisheries and for-hire recreational fishing are expected to result from pile driving. Section 3.4.1.1 discusses noise impacts on finfish, invertebrates, and EFH in further detail.

In the expanded cumulative scenario, construction of 2,066 offshore foundations, including turbines and ESPs, would create noise and temporarily impact fish and invertebrates (Section 3.4.1.1 includes details on extent of impacts), and indirectly, temporarily impact commercial fisheries and for-hire recreational fishing. The greatest impact of noise is likely to be caused by pile driving. Noise from pile driving would occur during installation of foundations for offshore structures. This noise would be produced during construction for 4 to 6 hours at a time over a 6- to 10-year period. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to fish and invertebrates in a limited space around each pile and can cause short-term stress and behavioral changes to individuals over a greater space. If the estimated (285 feet [87 meters]) injury/mortality zone for each of the 2,066 foundations in the expanded cumulative scenario were summed, the risk of injury or mortality is expected to occur over approximately 12,127 acres (49.0 km^2). The area of behavioral impacts would likely extend radially less than 5.7 miles (8 kilometers) around each pile. Finfish and invertebrate eggs, embryos, and larvae could also experience developmental abnormalities or mortality resulting from this noise, although thresholds of exposure have not been defined as they have been for adult finfish (Weilgart 2018, Hawkins and Popper 2017). In the area of behavioral effects, it is anticipated that some fishing activities may experience less catch due to movement of fish away from sounds sources and/or reduction catch efficiency in hook and line fisheries (Skalski et al. 1992). These direct impacts on fish could impact fishing activities if vessels need to temporarily relocate to other fishing locations in order to continue to avoid or reduce impacts on revenue. This could lead to increased conflict in those locations, increased operating costs for vessels (e.g., additional fuel costs), and lower revenue (e.g., less productive area; less valuable species). Due to the relatively small footprint of injurious sound and the ability for most fish to swim away from noise sources, it is not anticipated that injurious sound would have stock-level impacts on commercial fish species. As noted above, the area of behavioral effects is much larger than injurious effects. In the event that pile-driving noise were to negatively affect spawning behavior, then reduced reproductive success in one or more spawning seasons could result. This could potentially result in long-term effects on populations and harvest levels if one or more year classes suffer suppressed recruitment. However, the risk of reduced stock recruitment from pile-driving noise is considered low because the behavioral impacts on commercial fish species would only be present for the intermittent duration of the noise. After the cessation of pile-driving activity, fish behavior is expected to return to pre-construction levels (Jones et al. 2020; Shelledy et al. 2018).

Noise from G&G surveys of cable routes and other site characterization surveys for offshore wind facilities could also affect finfish and invertebrates, but is not anticipated to rise to fishery-level impacts since the noise would be very temporary in nature. G&G noise would occur intermittently over an assumed 2- to 10-year construction period. G&G noise resulting from offshore wind site characterization surveys is less intense than G&G noise from seismic surveys used in oil and gas exploration; while seismic surveys create high-intensity impulsive noise to penetrate deep into the seabed, offshore wind site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves more similar to common deep-water echosounders (Appendix A). Noise from G&G surveys, construction, trenching, vessel activity, and WTG operations and maintenance is expected to occur, but would have less of an impact on fish and invertebrates (Section 3.4.1.1 includes details on extent of impacts). This noise is expected to result in behavioral changes to commercial fish species that could impact the catch efficiency of some gears (hook and line), however, the noise from these sources is not anticipated to impact reproduction and recruitment of commercial fish stocks into the fishery. Impacts on commercial fisheries and for-hire recreational fishing would be localized, temporary, and adverse.

BOEM anticipates that there would likely be simultaneous noise-producing activities from offshore wind projects based on the estimated construction timeline presented in Appendix A. While simultaneous pile driving and other noise-producing activities may disrupt fishing activities over a larger area than if activities occurred sequentially, the total time of disruption would be less than if each project were to conduct pile driving or other noise-producing activities sequentially. BOEM does not anticipate differential injurious levels of impact on fishery resources based on whether pile-driving activities occur sequentially or concurrently due to the fact that the areas of injurious sounds would not overlap. The chance of exposure to behavioral levels of impact on fish populations is highly likely for concurrent projects in adjacent leases. Both fishing and fishery resources may be differentially impacted based on the season in which the activities occur. It is anticipated that most construction activities would take place in the summer due to more favorable weather conditions. Thus, fisheries and fishery resources most active in the summer will likely be impacted more than those that occur in the winter.

Port utilization: Ports are largely privately owned or managed businesses that are expected to compete against each other for offshore wind business. Major northeast fishing ports are listed in Table 3.11-2. Of those major fishing ports, New Bedford, Hampton Roads, Atlantic City, Ocean City, and Montauk have been identified as possible ports to support offshore wind energy construction and/or operations. Of those ports, only New Bedford and Hampton Roads have been identified as possible construction staging area ports. Other ports, including Vineyard Haven, could be used for operations and maintenance. Other non-major fishing ports could also be used for operation and maintenance support. Port expansions would likely happen over the next 6 to 10 years, and the increase in port utilization would increase vessel traffic, peaking during construction activities, decreasing during operations, and increasing again during decommissioning. An increase in vessel traffic could result in delays or restrictions in access to ports for commercial and for-hire fishing vessels. As ports expand, maintenance dredging of shipping channels could increase (including increased frequency of dredging to maintain existing authorized depths and projects to increase channel depth—as described in Section 3.13) and may cause restrictions and delays for fishing vessels trying to access port facilities. The risk of restrictions and delays to access port facilities due to dredging would only increase when actual dredging activities occur, which would be infrequent. 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.

Presence of structures: The presence of structures can lead to impacts on commercial fisheries and for-hire recreational fishing through allisions, entanglement or gear loss/damage, fish aggregation, habitat conversion, navigation hazards (including transmission cable infrastructure), and space use conflicts. These impacts may arise from buoys, met towers, foundations, scour/cable protection, and transmission cable infrastructure. Using the assumptions in Table A-4 in Appendix A, the expanded cumulative scenario would include up to 2,066 foundations, 1,723 acres (7.0 km^2) of foundation scour protection, and 1,221 acres (4.9 km^2) of new hard protection atop cables. Projects may also install more buoys and met towers. BOEM anticipates that structures would be added intermittently over an assumed 6- to 10-year period and that they would remain until decommissioning of each facility is complete.

Structures may alter the availability of targeted fish species in the immediate vicinity of the structures. For example structure-oriented fish such as black sea bass, striped bass, lobster, and cod may increase in areas where there was no structure (natural or artificial) previous to offshore wind infrastructure. Flatfish, clams, and squid species are likely to remain in open soft-bottom sandy areas. Furthermore, altered community composition could change natural mortality of certain species due to predation (decrease), refuge (increase), and increase competition between species, which could have indirect beneficial and adverse effects, depending on the species. These effects are not anticipated to result in stock level impacts that would in turn impact fisheries. Various attempts to measure the linear extent of the reef effect have reported distances from 52.5 feet (16 meters) (Stanley 1994) to 1,968.5 feet (600 meters) (Kang et al. 2011) from a structure, and Rosemond et al. (2018) have suggested assuming a distance of 98 to 197 feet (30 to 60 meters) as a first approximation. There would be no effect in areas that already contain natural or artificial structures. These impacts could lead to increased opportunities for for-hire recreational fisheries and private recreational anglers, which could lead in-turn to space conflicts with commercial fisheries. Section 3.4.1.1 includes a more detailed discussion on fish aggregation and habitat alteration.

Future offshore wind structures are anticipated to provide forage and refuge for some migratory species, including finfish and invertebrates (e.g., summer flounder, monkfish, black sea bass, and lobster). While these behavioral effects may impact individual fish, they are not anticipated to result in broad changes in migration patterns that would in turn impact fisheries. Other physical oceanographic conditions such as temperature and salinity are a bigger driver of seasonal migration (Moser and Shepard 2009; Fabrizio et al. 2014; Secor et al. 2018). Therefore, fishery-level impacts are not anticipated. Section 3.4.1.1 includes more details on the impacts of the presence of structures on finfish.

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. The presence of WTGs could also lead to long-term changes to fishing vessel transit routes during operations, which could affect travel time and trip costs. With respect to risk of fishing gear snares and maneuverability restrictions (including risk of allisions) within WDAs, fishermen have expressed specific concerns about fishing vessels operating trawl gear that may not be able to safely deploy gear and operate in a WDA 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 spacing between WTGs may not be enough to operate safely due to maneuverability of fishing gear and gear not directly following in line with vessel orientation. Clam industry representatives state that their operations require a minimum distance of 2 nautical miles between WTGs, in alignment with the bottom contours, for safe operations (Wallace 2019). Due to the mobile gear being actively pulled by a vessel over the seafloor, the chance of snagging mobile gear on Project infrastructure is much greater than if—in the case of fixed gear—the gear were 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 impact mobile and fixed-gear commercial fisheries and for-hire recreational fishing. Inter-array and export cables would be buried below the seabed approximately 4 to 6 feet (1.2 to 1.8 meters); however, BOEM assumes that no more than 10 percent of the cables may not achieve the proper burial depth and would require cable protection in the form of rock placement, concrete mattresses, and/or half-shell. Mobile bottom-tending gear (trawl and dredge gear) could get hung up on these cable protection measures, and the cost of these impacts would vary depending on the extent of damage to the fishing gear.

Maneuverability within WDAs would vary depending on many factors, including vessel size, fishing gear or method used, and weather conditions. Navigating through the WDAs 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 make maneuverability difficult. However, trolling for highly migratory species (bluefin tuna, swordfish) may involve many feet of lines and hooks behind the vessel and then following large pelagic fish once they are hooked, posing additional navigational and maneuverability challenges around WTGs. As presented below, the orientation of vessels transiting and fishing within the southern New England lease areas varies by activity, fishery, and area. Figures 3.11-1 through 3.11-6 show the directionality of vessel monitoring system (VMS) enabled fishing vessels. This analysis uses the information conveyed in each individual position report (ping), which includes all fishing vessels, parsed into two speed categories representing transiting (speeds greater than or equal to 5 knots) and fishing activity (speeds less than 5 knots). The histograms on Figures 3.11-1 through 3.11-6 were chosen because they show how the orientation of vessels varies by activity, fishery, and area and how this can be used to support different alternatives (discussed in Section 3.11.2). The polar histograms are generated from all position reports broadcasted within a certain area (the combined RI and MA Lease Areas and the WDA), and represent most fishing and transit activity for fisheries with VMS requirements. The larger bars represent a greater number of position reports showing fishing vessels moving in a certain direction within the southern New England lease areas or the WDA. Overall, the plots show variability among activity type, fishery, and between a single project (i.e., WDA) versus the cumulative scenario across the southern New England leases (RI and MA Lease Areas).

Figure 3.11-1 and Figure 3.11-2 show the directionality of fishing vessels across the combined RI and MA Lease Areas. Figure 3.11-1 shows a majority of the 466 unique vessels fishing moving in a direction 10 to 15 degrees off of due east-west throughout the southern New England lease areas. This direction is generally consistent with the former Loran lines. Figure 3.11-2 shows a majority of the 668 unique vessels transiting in a northwest-southeast direction through the southern New England lease areas. Figure 3.11-3 shows that the volume of actively transiting position reports created within the WDA greatly exceeds the volume of actively fishing position reports, showing a stronger northwest-southeast direction signal. The figures demonstrate a predominantly northwest-southeast transit pattern and slightly northeast-southwest fishing pattern in most of the southern New England lease areas, with a more prominent northwest-southeast and southeast-northwest transit and fishing pattern in the vicinity of the WDA (Figures 3.11-3 and 3.11-4).

Some of the figures show variability among fishery type. Figure 3.11-5 shows a majority of the 418 unique vessels in the sea scallop fishery transiting in a northwest-southeast direction through the southern New England lease areas. Figure 3.11-6 shows a majority of the 92 unique vessels in the squid, mackerel, butterfish fishery fishing in a near east-west direction throughout the southern New England lease areas.

VMS is a good data source for understanding the spatial distribution of fishing vessels in the Northeast Region. In 2018 there were 912 VMS enabled vessels operating in the Northeast across all fisheries. These 912 vessels represented a substantial portion (71 to 87 percent) of summer flounder, scup, black sea bass, and skate landings, and greater than 90 percent of landings for scallops, squid, monkfish, herring, mackerel, large mesh multispecies, whiting, surfclams, and ocean quahogs. VMS vessels represented less than 20 percent of HMS and 10 percent of lobster/Jonah crab landings (NMFS 2020). Of these vessels, approximately 67 percent fished or transited all reasonably foreseeable project areas, and 40 percent (366 vessels) fished or transited in the WDA in 2018 (NMFS 2019b).

As described in Chapter 2, the USCG's ongoing MARIPARS is evaluating the need for establishing vessel routing measures. The draft study was published on January 29, 2020, and the USCG will make a final recommendation on transit routes after the comments received during the Draft MARIPARS report comment period are assessed. Overall, future offshore wind projects would have long-term, adverse impacts on commercial and for-hire fisheries due to the reduced area available for fishing and the navigation hazards to fishing vessels, especially larger commercial fishing vessels. Project proponents, as in the case of Vineyard Wind, may mitigate the economic losses of commercial and for-hire fisheries resulting from these impacts.

Installation of offshore cables for each offshore wind energy facility would require temporary re-routing of all vessels away from areas of active construction, including commercial and for-hire recreational fishing vessels. During operations, periodic cable maintenance and repair could have similar impacts, although these activities would be less frequent and extensive than installation.

The location of proposed offshore wind energy structures could affect the accessibility and/or availability of fish for commercial and for-hire fisheries. Potential displacement of fishing vessels and increased competition on fishing grounds could have long-term adverse impacts on commercial fisheries and for-hire recreational fishing. As mentioned above, in 2017 there were 4,300 federally permitted vessels operating in the Northeast across all fisheries. The cumulative scenario would impact all fisheries and all gear types (NOAA 2019e). Bottom tending mobile gear is more likely to be displaced than fixed gear. The 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.

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. There could be increased gear conflicts as commercial fisheries and for-hire recreational fishing compete for space between turbines, especially if there is an increase in recreational fishing for structure-affiliated species attracted to the foundations (e.g. black sea bass). Commercial fishing vessels have well-established and mutually recognized traditional fishing locations or may be restricted on where they can fish due to fishery regulations. The relocation of fishing activity outside of WDAs 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.

One way to understand the level of commercial fishing activity that could be impacted is by looking at revenue exposure. Revenue exposure quantifies the dockside value of fish reported as being caught in individual wind lease areas. It is a starting point to understanding potential economic impact of future offshore wind project development if a harvester opts to no longer fish in the area and cannot recapture that income in a different location. Revenue exposure measures should not be interpreted as a measure of economic impact or loss. Actual economic impact would depend upon many factors—foremost, the potential for continued fishing to occur within the footprint of the wind lease area, as well as the availability of target species within the project areas. Economic impacts also depend on a vessel's ability to adapt by changing where it fishes. For example, if alternative fishing grounds are available nearby, or if alternative fishing methods are implemented, the economic impact would be lower. Thus, when aggregating across all fisheries (mobile and fixed gear) and all years, the revenue exposure estimate is a very conservative estimate of actual impacts.

Projected revenue exposure measures are based on the entire area or footprint of a given lease area and the year that future projects are assumed to be constructed (Table A-6 in Appendix A). Using the assumed construction schedule, Table 3.11-3 shows the projected average annual percentage of total northeast fishery revenue exposed, by fishery management plan for 2020 through 2030. BOEM calculated future revenue exposure based on the annual average value of landings from 2007 to 2018 found within the future wind energy facility footprints, as a percentage of the average total coast-wide value of landings. This analysis assumed that revenue exposure started in Year 1 of construction of each proposed or potential future wind energy project shown in the assumptions in Table A-6in Appendix A, and continued through 2030 when the last project in the analysis is anticipated to be constructed. Actual impacts would extend throughout the entire operation of the facilities. Table 3.11-4 shows the percent of port revenue coming from all project areas included in the expanded cumulative scenario for average landings between 2013 and 2018. The four landing port groups with the highest average annual revenue from all lease areas are: New Bedford, Massachusetts; Point Judith, Rhode Island; Atlantic City, New Jersey; and Cape May, New Jersey. The highest revenue by dollar and percent exposure is Point Judith, Rhode Island. This is driven primarily by squid landings from leased areas offshore Massachusetts and Rhode Island. Atlantic City's exposure is driven primarily by surfclam landings in leased areas offshore New Jersey. However, smaller ports like Little Compton, Rhode Island, show a high dependency but a relatively small average annual landings. Dependency will vary over time, by port, by fishery, and/or by vessel.

The results in Table 3.11-3 show increased revenue exposure as more offshore wind energy facilities are developed, although the overall cumulative percentage of revenue exposure remains relatively small for the majority of fisheries. A majority of the fisheries would have less than 2 percent of total revenue exposed by future offshore wind development. Some fisheries that have a high percentage of revenue exposure, such as skate (7.08 percent), have a relatively low average annual nominal dollar exposure ($582,748), while other fisheries like sea scallop have relatively low percent exposure (0.77 percent) but high average annual dollar value (greater than $3 million). The fishery with the largest combined percent exposure and dollar value is the Atlantic surfclam and ocean quahog fishery, which has high surfclam landings in lease areas offshore New Jersey and ocean quahog landings south of Cox Ledge. This analysis includes the WDA and all lease areas within the expanded cumulative analysis. While all federally managed fisheries are required to submit a Vessel Trip Report (VTR), some fisheries like American lobster and Jonah crab do not have that requirement unless they are also landing a federally managed species. Thus lobster and Jonah crab landings are captured in the "None – Unmanaged" row. According to NMFS, VTRs capture between 31percent (Connecticut) and 100 percent (Virginia and Maryland) of lobster landings between 2014 and 2019. Massachusetts and Rhode Island averaged 60 and 70 percent respectively over the same time period. Similarly VTR-required vessels landed between 18 and 100 percent of Jonah crabs in New England and the Mid-Atlantic (B. Galuardi, Pers. Comm., 2020). If some of these wind energy facilities are not built, the exposed average annual revenue percentages in Table 3.11-3 would overestimate actual revenue exposure over time.

Increased vessel traffic: Increased vessel traffic associated with future offshore wind development could increase congestion, delays at ports, and the risk for collisions with fishing vessels. As stated in Section 3.13, future offshore wind projects would result in a small incremental increase in vessel traffic, with a peak during surveys and construction over a 6 to 10 year period, particularly when future offshore wind project construction activities overlap as shown in Table A-6 in Appendix A. The presence of construction vessels could restrict harvesting activities in WDAs and along cable routes during installation and maintenance activities.

Climate change: Commercial fisheries and for-hire recreational fishing may be affected by climate change. The primary driver of change associated with climate change is an increase in sea surface and bottom temperature. Warming of ocean waters has been shown to impact the distribution of fish in the northeast U.S. by several species shifting the center of biomass either northward or to deeper waters. These changes have, and will continue to, change the distribution of commercial fishing effort (Hare et al. 2016). Implementation of offshore wind projects will likely result in a net decrease in GHGs as fossil fuel-type facilities reduce operations as a result of increased energy generation from offshore wind projects. This reduction in GHG emissions will offset any small increase in GHG emissions from offshore wind projects. Overall, it is anticipated that there will be no impact on climate change as a result of offshore wind projects alone, though they may beneficially contribute to a broader combination of actions to reduce future impacts from climate change. The construction of offshore wind facilities are not expected to impact climate change and thus adverse impacts on commercial fisheries are not expected through this IPF. Refer to Section A.8.1 for details on the expected contribution of offshore wind activities to climate change.

Regulated fishing effort: Regulated fishing effort refers to fishery management measures necessary to maintain maximum sustainable yield under the Magnuson–Stevens Fishery Conservation and Management Ac. This includes quota and effort allocation management measures. Offshore wind development could influence regulated fishing effort by two primary pathways, by changing fishing behavior to such an extent that overall harvest levels are not as predicted, and by impacting fisheries scientific surveys on which management measures are based. If scientific survey methodologies are not adapted to sample within wind energy facilities, then there could be increased uncertainty in scientific survey results, which would increase uncertainty in stock assessments and quota setting process. Future spatial management measures may change in response to changes in fishing behavior due to the presence of structures. Impacts on management processes would in turn have short-term or long-term impacts on commercial and for-hire recreational fisheries operations. Section 3.14 discusses cumulative impacts on scientific surveys.

3.11.1.2. Conclusions

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impacts on commercial fisheries and for-hire recreational fishing. BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing temporary to permanent adverse impacts on commercial fisheries and for-hire recreational fishing, primarily through new cable emplacement, G&G survey noise, pile-driving noise, port expansion, presence of structures, vessel traffic, climate change, and regulated fishing effort. The extent of impacts on commercial fisheries and for-hire recreational fishing will vary by fishery due to different target species, gear type, and location of activity.

Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in major adverse impacts on commercial fisheries and moderate adverse impacts on for-hire recreational fishing due to the presence of structures (gear loss, navigational hazard, and space use conflicts). The majority of offshore structures in the geographic analysis area for commercial fisheries and for-hire recreational fishing would be attributable to the offshore wind industry. The offshore wind industry would also be responsible for the majority of impacts related to new cable emplacement and to pile-driving noise. However, BOEM expects that ongoing impacts resulting from regulated fishing effort would continue to be one of the most impactful IPFs controlling the condition of commercial and for-hire fisheries in the geographic analysis area.

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 and societal activities. The No Action Alternative would forgo the construction, operations, decommissioning, and environmental monitoring programs proposed by the lessee. Fisheries monitoring initiatives proposed by the lessee would not be available for understanding impacts of future wind energy development projects, although other data sources could still be used to answer similar questions.

3.11.2. Proposed Action and Action Alternatives

3.11.2.1. Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on commercial fisheries and for-hire recreational fishing were described in the Draft EIS Section 3.4.5.3, and additional information is included in Table 3.11-1. The Proposed Action would likely result in impacts (displacement, disruption, navigational hazards, entanglement and gear loss/damage, space use and gear conflicts) that are expected to be local and short-term or long-term. This analysis assumes the maximum-case scenario. The Proposed Action includes the voluntary measures Vineyard Wind has committed to implement, which establish financial compensation agreements for Massachusetts and Rhode Island-based fisheries groups and are outlined in Table 3.11-5 and in the May 2019 COP (COP, Addendum to Volume III; Epsilon 2019a).

The Proposed Action would contribute to impacts through all of the IPFs named in Section 3.11.1.1, except for a sub-factor in port utilization; the Proposed Action would not involve port upgrades. The most impactful IPF caused by the Proposed Action would likely be the presence of structures, which would lead to permanent impacts, including space use conflicts, effort displacement, navigational hazards, entanglement and gear loss/damage, as well as fishery changes due to habitat conversion. These impacts are anticipated to be adverse in the near-term but may become neutral over time if fishing practices adapt to the presence of structures. Other IPFs would likely contribute impacts of lesser intensity and extent, and would occur primarily during construction, but also during operations and decommissioning.

Three IPFs or sub-IPFs in Table 3.11-1 were not discussed previously in the Draft EIS sections regarding commercial fisheries and for-hire recreational fishing. Impacts from anchoring were discussed only in Draft EIS Section 3.3.5.3. Subsequent to publication of the Draft EIS, BOEM decided to assess specifically the potential impacts of anchoring on commercial fisheries and for-hire fishing. Anchoring vessels used in the course of the proposed Project would pose a navigational hazard to fishing vessels. The proposed Project estimated that anchoring would disturb up to 4 acres (0.02 km^2). All impacts would be localized and potential navigation hazards would be temporary (hours to days). The anticipated direct and indirect impacts of anchoring on commercial fisheries and for-hire recreational fishing would be minor. Anchoring impacts on finfish, invertebrates, and EFH are discussed in Section 3.4.2.

The Draft EIS also did not consider noise from offshore wind G&G surveys because offshore wind G&G surveys were assessed through a previous NEPA analysis and authorization (BOEM 2014a). BOEM is assessing the impacts of ongoing pre-construction G&G surveys in support of reasonably foreseeable offshore wind projects and post-construction G&G surveys used for monitoring performance of project infrastructure, such as proper cable burial. G&G noise resulting from infrastructure inspections can temporarily disturb fish and invertebrates in the immediate vicinity of the survey, causing a temporary behavior change, including leaving the area affected by the sound source and reducing foraging activity (biting hooks). Impacts on commercial fisheries and for-hire recreational fishing would depend on the duration of the noise producing activity coinciding with fishing and are anticipated to be negligible to minor. G&G noise impacts on finfish, invertebrates, and EFH are discussed in Section 3.4.2.

Finally, the Draft EIS also did not describe how the presence of structures could potentially affect fish migration, but comments received since publication of the Draft EIS has prompted inclusion of this potential effect. The nature of this sub-IPF and of the impacts on commercial fisheries and for-hire fishing are described in detail in Section 3.11.1.1. The Proposed Action could result in up to 102 foundations which would result in 53 acres (0.21 km^2) of scour protection at the base of the foundation and 98 acres (0.5 km^2) of cable protection that could influence residency time of fish migrating through the area (Section 3.11.1.1). These impacts would likely be negligible to commercial fisheries and for-hire recreational fishing.

Changes to the design capacity of the WTG proposed in the Vineyard Wind COP (Epsilon 2020a), as compared to the WTGs evaluated in the Draft EIS, would not alter the maximum potential impacts on commercial fisheries and for-hire recreational fishing for the Proposed Action and all other action alternatives because the maximum-case scenario involved the maximum number of WTGs (100) allowed in the PDE. Changes to the design of the onshore substation would also not alter the potential impacts on fishery resources for the Proposed Action and all other action alternatives because the proposed substation site is inland and would have no impact on fishery resources.

The cumulative impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are listed by IPF in Table 3.11-1. The natures of the primary IPFs and of potential impacts on commercial fisheries and for-hire recreational fishing are described in detail in Section 3.11.1.1. Under the No Action Alternative, BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities other than the Proposed Action to continue to have temporary to permanent impacts on commercial fisheries and for-hire recreational fishing, primarily through the following IPFs: regulated fishing effort, pile-driving noise, new cable emplacement, the presence of structures, and climate change.

The cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities would be of similar types to those described in Section 3.11.1.1 and 3.11.1.2, but may differ in intensity and extent. It is assumed that the regional state energy demand that the Vineyard Wind 1 Project would fill (if approved) would likely be met by other projects in remaining areas of the Massachusetts, Rhode Island, and/or New York leases (if not approved). Although the impacts from a substitute project may differ in location and time, depending on where and when offshore wind facilities are developed to meet the remaining demand, the nature of impacts and the total number of WTGs would be similar either with or without the Proposed Action, as described in Section 3.11.1.1. In other words, future offshore wind facilities capable of generating 9,404 MW would be still be built in RI and MA Lease Areas, although, in the absence of the Proposed Action, none would be built before 2021.

Anchoring: Vessel anchoring would cause temporary impacts on fishing vessels and fishing activities. Impacts on finfish, invertebrates, and EFH are discussed in Section 3.4.2. In the cumulative scenario, there would be increased anchoring of vessels during survey activities and during the construction, installation, maintenance and decommissioning of offshore components. In addition, there could be increased anchoring/mooring of met/oceans buoys. Cumulatively, anchoring could affect up to approximately 276 acres (1.1 km^2). Of this area, 4 acres (0.02 km^2) would result from the Proposed Action, likely leading to minor impacts, and the remainder is the estimated result of other offshore wind projects in the geographic analysis area. All impacts would be localized and temporary (hours to days). The cumulative impacts from anchoring on commercial fisheries and for-hire recreational fishing associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are anticipated to be minor.

New cable emplacement and maintenance activities: The Proposed Action would result in up to 321 acres (1.3 km^2) of seafloor disturbance by cable installation and up to 69 acres (0.3 km^2) as a result of dredging prior to cable installation. Construction and installation of the Proposed Action could prevent deployment of fixed and mobile fishing gear in limited parts of the WDA for 1 day to up to several months (if simultaneous lay and burial techniques are not used), which may result in the loss of revenue if alternative fishing locations are not available. The Proposed Action would result in localized, temporary, and minor impacts. Although cable routes and lengths for most other offshore wind projects are not known at this time, using the assumptions in Table A-4in Appendix A, the total seafloor disturbance from new cable emplacement within the geographic analysis area is estimated to be 8,153 acres (33.0 km^2). Cumulatively, cable-laying activities would not restrict large areas, and navigational impacts would be on the scale of hours. The cumulative impacts from new cable emplacement and maintenance activities on commercial fisheries and for-hire recreational fishing associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are anticipated to be localized, temporary, and minor.

Noise: The negligible to minor incremental impacts from noise associated with the Proposed Action would not considerably increase the impacts of noise beyond the impacts under the No Action Alternative. The cumulative impacts from noise on commercial fisheries and for-hire recreational fishing associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be highly similar to the impacts under the No Action Alternative due to the number of projects and ongoing activities and would range from **negligible** to **moderate** based on the sub-IPFs identified in Table 3.11-1.

Port utilization: Because the Proposed Action would cause no change in port utilization, no cumulative impacts of this IPF on commercial fisheries and for-hire recreational fishing can be attributed to the Proposed Action, although ongoing and future activities, including other offshore wind projects, are expected to cause some impacts. The impacts of increased vessel traffic are discussed under the vessel traffic IPF, and Section 3.13.2 includes a discussion on ports being used for the Proposed Action.

Presence of structures: The various types of impacts on commercial fisheries and for-hire recreational fishing that could result from the presence of structures, such as entanglement and gear loss/damage, navigational hazard and risk of allisions, fish aggregation, habitat conversion, effort displacement, and space use conflicts are described in detail in Section 3.11.1.1. The impacts from the presence of structures associated with the Proposed Action on commercial fisheries and for-hire recreational fishing are anticipated to range from **negligible** to **moderate** based on the sub-IPFs identified in Table 3.11-1, and would not increase the impacts across entire fisheries beyond those of the No Action Alternative. However, the cumulative effect on individual fishing businesses/fisheries depends largely on where the fishery is prosecuted. For example, as described previously, the incremental impact of the Proposed Action on the surfclam and ocean quahog fishery is small since most of that fishery activity is outside the WDA. Whereas the incremental impact on the squid fishery is much larger since that fishery has more activity in the WDA.

Cumulatively, using the assumptions in Table A-4 in Appendix A, there could be up to 2,066 foundations and 2,944 acres (12 km^2) of scour and cable protection. Of this area, 102 foundations and 151 acres (0.6 km^2) of scour and cable protection would result from the Proposed Action, and the remainder is the estimated result of other offshore wind projects in the geographic analysis area. The structures and the consequential impacts would remain at least until decommissioning of each facility is complete.

The Proposed Action's structures could impact accessibility and/or availability of fish and transit in the WDA and OECC, and would thus impact commercial fisheries and for-hire recreational fishing, to the extent that effort is removed from the WDA. Restrictions on maneuverability due to the presence of structures in the WDA could displace some fishing vessels, increasing conflict over alternative fishing grounds. While the Proposed Action may affect all fisheries and all gear types, there are some gear types that may be more adversely affected. Bottom tending mobile gear is more likely to be displaced than fixed gear. The fixed gear fisheries, including the lobster and gillnet fisheries, are less likely to be displaced from the WDA. However, some fixed gear methodologies, like the length of the pot trawl, may be modified to improve performance in a wind facility. Dredge gear fisheries, including the sea scallop fishery and surfclam/ocean quahog fishery, are not very active in the WDA and generally use shorter tows than trawl fisheries. The small mesh bottom fishery targeting whiting and squid are most likely to be impacted. Under the Proposed Action the WTG layout is designed such that the foundations would be in a northwest/southeast alignment. As the VMS-based polar histograms show (Figures 3.11-1), this would primarily benefit transiting fishing vessels (primarily scallop) from New Bedford to fishing grounds on Georges Bank. However, this layout would not align with fishing patterns observed in adjacent project areas (Figure 3.11-2). If the Proposed Action facility design was responsive to fishing vessel activity patterns in just the WDA, the cumulative impact of different spacing and orientation would be greater than if the Project were to adopt a uniform layout consistent with adjacent project areas to facilitate both fishing and transiting. The cumulative impact of the Proposed Action combined with future offshore wind projects is greater to fishing activity and less impactful for transiting activity. Some displaced fishing vessels may not opt to or may not be able to fish in alternative fishing grounds. If mobile gear fisheries are shifted, there could be space use conflicts between mobile and fixed-gear fisheries. Vineyard Wind has committed to voluntarily establish gear loss and revenue compensation funds for fishing interests in Rhode Island and Massachusetts, which is intended to compensate for gear and/or revenue losses over the life of the Project (Table 3.11-5). Future mitigation measures may reduce some of the economic impacts on the commercial and for-hire fleet (COP Volume III, Section 7.6; Epsilon 2019a).

The Proposed Action and other future offshore wind development would impact commercial fishing revenue. Section 3.11.1.1 includes further details. Table 3.11-3 shows the predicted average annual percentage of total Mid-Atlantic and New England fishery revenue exposed by fishery (as defined in the relevant fishery management plan) for 2020 through 2030. The WDA would only account for a small portion of the exposed revenue in the New England and Mid-Atlantic regions. The average annual percentage of total Mid-Atlantic and New England fishery revenue exposed by fishery within only the WDA (2021) would be less than 0.5 percent for all fisheries but will vary greatly between individual fisheries in certain years (Table 3.11-3). For example, the squid fishery may average around $215,000 from the WDA, but in 2016 it harvested close to $1 million (1.62 percent of total revenue) from the WDA (Draft EIS Figures 3.4.5-7a and 3.4.5-7b). Cumulatively, the average annual percentage of fishery revenue exposed throughout the construction timeline for all existing lease areas ranges from 0.13 percent ($2,262 revenue exposed for HMS) to 7.08 percent ($582,748 revenue exposed for Skate Fisheries Management Plan [FMP]). The average annual fishery revenue exposed by fishery ranges from $2,262 (HMS) to $3,538,272 (Scallop FMP). Section 3.11.1.1 and Table 3.11-3 provide a more detailed discussion of fishery revenue exposure. The cumulative impacts from the presence of structures associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities on commercial fisheries and for-hire recreational fishing are anticipated to range from **negligible** to **major** based on the sub-IPFs identified in Table 3.11-1.

Increased vessel traffic: As described in Section 3.13.2, the Proposed Action would generate a small incremental increase in vessel traffic (compared to the overall cumulative scenario), with a peak during the proposed Project construction. During construction and installation, Vineyard Wind anticipates an average of approximately 25 vessels operating during a typical workday in the WDA and along the OECC, including an estimated 18 vessel trips per day to or from ports. Vineyard Wind's proposed marine coordinator and vessel traffic management plan would mitigate the potential impacts of increased traffic congestion, competition for dockside services, and lower the risk of collisions associated with the proposed Project's increased marine traffic; therefore, fishery-level impacts would be **minor**. As shown in Figure 3.11-3, a majority of the 538 unique fishing vessels transit and fish in a northwest-southeast direction through the WDA. In 2017 there were 4,300 federally permitted vessels operating in the Northeast across all fisheries, and ongoing activities, future activities, and other future offshore wind development could incrementally impact commercial fishing vessels as more projects are developed. The cumulative impacts from increased vessel traffic on commercial fisheries and for-hire recreational fishing associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are anticipated to range from minor to moderate.

Climate change: This IPF would contribute to shifting distributions of commercial and for-hire fisheries. Because this IPF is a global phenomenon, the cumulative impacts through this IPF would be similar to those under the No Action Alternative. Implementation of offshore wind projects will likely result in a net decrease in GHGs and more details on this IPF can be found in Section 3.11.1.1. The intensity of cumulative impacts resulting from climate change are uncertain, but are anticipated to qualify as minor to moderate.

Regulated fishing effort: This IPF would contribute to short-term and long-term moderate impacts on commercial fisheries and for-hire recreational fisheries operations, as described in detail in Section 3.11.1.1 and in Table 3.11-1. The incremental effects of the Proposed Action with fisheries regulations would increase impacts on commercial fisheries beyond those of the No Action Alternative. However, the extent of impacts from offshore wind development on regulated fishing effort is difficult to predict. The impacts would vary depending on the fishery and the changes in fishing behavior due to of offshore wind development. Fishing regulations may have less flexibility in area-based management, and offshore wind may change the distribution of fishing effort in ways not contemplated in fishery management plans. Additionally, impacts on fisheries scientific surveys may result in more conservative quota and effort management measures. Considering the information above, the cumulative impacts of regulated fishing effort on commercial fisheries and for-hire recreational fishing associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are anticipated to be moderate.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from negligible to major. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in major impacts on commercial fisheries and for-hire recreational fishing in the analysis area. The financial compensation agreements outlined in Table 3.11-5 may result in a lower impact specific to the Proposed Action; however, these compensation measures are not currently in place for other future offshore wind projects. This impact rating is driven mostly by changes to fish distribution/availability due to climate change, reduced stock levels due to fishing mortality, and permanent impacts due to the presence of structures (cable protection measures and foundations).. The Proposed Action would contribute to the overall impact rating primarily through permanent impacts from the presence of structures (cable protection measures and foundations), including navigation hazards, gear loss and damage, and space use conflicts. Thus, the overall cumulative impacts on commercial fisheries and for-hire recreational fishing qualifies as major because the fishing industry would experience unavoidable disruptions beyond what is normally acceptable, but mitigation, including financial compensation and uniform spacing and layout across adjacent projects, could reduce impacts if adopted for future offshore wind projects.

3.11.2.2. Cumulative Impacts of Alternative B

The direct and indirect impacts of Alternative B on commercial fisheries and for-hire recreational fishing are described in the Draft EIS Section 3.4.5.4. The only difference from Alternative B to the Proposed Action is the selection of Covell's Beach as the landfall site; therefore, impacts on the Lewis Bay shellfish beds and summer flounder would be avoided. The New Hampshire landing site has high to very high density of fishing vessels targeting squid, medium high density of vessels targeting surfclam and ocean quahog, medium-high to high density of vessels targeting sea scallop, and typically a higher number of vessel transit counts (Draft EIS Figures 3.4.5-2, 3.4.5-5, 3.4.5-6, 3.4.5-8, and 3.4.5-9). However, at the Covell's Beach site, those densities are very low. Further, no important fishing spots have been identified on Covell's Beach or in Centerville Harbor (Town of Barnstable 2009). In general, Vineyard Wind's Supplemental Draft Environmental Impact Report (Epsilon 2018b) identifies the New Hampshire Avenue landing site as having more impacts on commercially important shellfish than Covell's Beach. In other respects, the incremental impacts of Alternative B on commercial fisheries would be the similar to those of the Proposed Action and similar but to a lesser degree for-hire recreational fishing since Covell's Beach has lower nearshore fishing vessel traffic as compared to Lewis Bay. Overall, the direct and indirect impacts of Alternative B on commercial fisheries and for-hire recreational fishing would likely be moderate.

Although BOEM expects Alternative B would have reduced impacts on fishing in state waters and on for-hire recreational fishing due to avoiding impacts in Lewis Bay, the overall cumulative impacts of Alternative B on commercial fisheries would likely be very similar to those of the Proposed Action as discussed in the preceding paragraphs with individual IPFs leading to impacts ranging from negligible to major. The overall cumulative impacts of Alternative B when combined with the past, present, and reasonably foreseeable activities would result in major impacts on commercial fisheries and for-hire recreational fishing. This impact rating is driven mostly by changes to fish distribution/availability due to climate change, reduced stock levels due to fishing mortality, and permanent impacts due to the presence of structures (cable protection measures and foundations).

3.11.2.3. Cumulative Impacts of Alternative C

The direct and indirect impacts of Alternative C on commercial fisheries and for-hire recreational fishing are described in the Draft EIS Sections 3.4.5.5. The incremental impacts of Alternative C would be very similar to those of the Proposed Action (moderate impacts on commercial fisheries and for-hire recreational fishing) because the construction activities and amount of structure would be highly similar to those under the Proposed Action. Alternative C would provide more unobstructed space for navigation in the northern portion of the WDA, which is commonly used by commercial and for-hire fisheries (as shown on Figure 3.4.7-1 of the Draft EIS). Moving WTGs away from the northern portion could improve transit for the scallop fishery that has higher vessel density in that portion of the WDA. The shifting of these WTGs to a more southern location within the WDA would not alter the size of the WDA footprint, and thus would not change the impact on commercial fishing activity. Therefore, BOEM anticipates Alternative C would have a similar impact on commercial fisheries and for-hire recreational fishing as the Proposed Action.

Although BOEM expects Alternative C would have reduced impacts on fishing transit from Massachusetts and Rhode Island ports to offshore fishing grounds, the overall cumulative impacts of Alternative C on commercial fisheries would likely be very similar to those of the Proposed Action as discussed in the preceding paragraphs with individual IPFs leading to impacts ranging from **negligible** to **major**. The overall cumulative impacts of Alternative C when combined with the past, present, and reasonably foreseeable activities would result in **major** impacts on commercial fisheries and for-hire recreational fishing. This impact rating is driven mostly by changes to fish distribution/availability due to climate change, reduced stock levels due to fishing mortality, and permanent impacts due to the presence of structures (cable protection measures and foundations).

3.11.2.4. Cumulative Impacts of Alternative D

The direct and indirect impacts of Alternatives D1 and D2 on commercial fisheries and for-hire recreational fishing are described in the Draft EIS Section 3.4.5.6 and Draft EIS Section 3.4.5.7. The incremental impacts of either of these alternatives would be very similar to those of the Proposed Action (**moderate** impacts on commercial fisheries and on for-hire recreational fishing). Additional site characterization surveys may result in increased vessel activity prior to construction, which would cause local temporary disruptions to fishing activities.

Both alternatives would establish a slightly wider spacing of WTGs in the WDA, causing an increase in temporary disruption to access from increased WDA area (22 percent increase in area), lengthier construction and installation time, potential decreases in accessibility to/availability of fish within the WDA as Project components would be distributed throughout a larger OCS area. The wider spacing could also cause an increase in displacement of fishing vessels as a result of now larger WDA, leading to increased conflict over other fishing grounds. However, these adverse impacts are at least partially offset by for some fisheries by the artificial reef effect associated with the infrastructure surface area (cable protection, foundations/scour protection) due to placement of the WTGs and ESPs. The wider spacing would also improve maneuverability in fishing locations and the ability of vessels to deploy mobile and fixed fishing gear given the east-west orientation (only Alternative D2) and increased spacing between the WTGs except for some commercial fisheries in the northern portion of the WDA.

The increased spacing would not result in a substantial reduction in cumulative impacts as the analysis area includes Cape Hatteras to the Gulf of Maine, but may result in extensive Project delays, as specified in the Draft EIS, as a result of required additional biological, geological, and geotechnical survey work. The direct and indirect impacts of Alternative D1 would be similar to those of the Proposed Action (**moderate** impacts on commercial fisheries and for-hire recreational fishing) but to a lesser degree for fishing vessels due to the increased WTG spacing and to a greater degree due to the increased overall size of the WDA.

Also, the increased size of the WDA could incrementally increase effects on vessel traffic, compared to the Proposed Action; however, some Rhode Island-based commercial fisheries groups and the Rhode Island Coastal Resources Management Council have asserted that Alternative D2 would improve maritime navigation and facilitate continued fishing operations and practices within the WDA compared to the Proposed Action due to the orientation of the turbines. The USCG in the Draft MARIPARS report has also recommended a layout similar to D2 for the entirety of the RI and MA Lease Areas. To the extent to which certain vessels and gear types choose to fish within wind energy arrays that may be built in federal waters offshore Massachusetts and Rhode Island, an east-west turbine orientation may slightly lessen (but not eliminate) impacts on those operators (Annie Hawkins, Pers. Comm., November 16, 2018).

While there is a current east-west traffic in the WDA, there is also northwest-southeast traffic in the northern portion of the WDA. Fishermen have stated that there is an unwritten gentlemen’s agreement between mobile and fixed gear vessels where fixed gear fishermen deploy their gear in a roughly east-west direction along Loran lines whose numbers end in 0 and 5 and mobile gear fishermen tow in between in an east-west direction (Mattera 2018). This has been reflected in the polar histograms for active fishing speed position reports in Figure 3.11-4. Mobile gear fishermen avoid towing where fixed gear is deployed to avoid entanglements and damage to fishing gear, while fixed gear fishermen tend to avoid mobile gear fishing to avoid damage to pots or traps. The east-west orientation could minimize the mobile and fixed gear interactions. Alternative D2 would allow the fixed and mobile gear commercial fishing operations to continue to operate within the WDA (with modifications to gear and operations) in a manner that the commercial fishing industry can coexist with the offshore wind energy industry with only slight adjustments to traditional fishing orientation.

For Alternative D2, direct and indirect impacts would be similar to the Proposed Action (**moderate** impacts on commercial fisheries and for-hire recreational fishing) but potentially to a lesser degree for some fishing vessels or a greater degree for others due to the orientation of the WTGs and the increased size of the WDA. Under Alternative D2 the facility design is in an east/west alignment. There would be four lines of orientation: two allowing for directional travel 1 nautical mile wide north-south and east-west and two allowing for 0.7 nautical mile northwest-southeast and northeast-southwest. As the VMS-based polar histograms show (Figures 3.11-3 and 3.11-4) this would be about 10 to 15 degrees offset from the predominant vessel orientation at active fishing speeds and allow for theoretical 0.7 nautical mile transit lanes in the northwest-southeast transiting direction in the WDA. However, the layout in Alternative D2 would align with fishing patterns observed in adjacent project areas (Figure 3.11-2). If adjacent projects ultimately implement a uniform 1x1-nautical-mile WTG spacing with east-west/north-south orientation as BOEM assumes would occur under the cumulative scenario for southern New England, the impacts from the presence of structures on navigation hazards would be reduced. The incremental cumulative adverse impact of the Alternative D2 is greater to transiting activity, and less impactful for fishing activity. The benefits of an east-west orientation that is more in line with some current fishing practices is at least partially offset by the adjustment other fishing vessels that do not operate in an east-west direction would have to make. Alternative D1 and D2 could improve maritime fishing and transit due to the increased and uniform spacing between WTGs. However, the increased WDA would also result in a larger overall footprint which decreases facility design flexibility for future projects.

Although BOEM expects that Alternative D1 and D2 would have reduced impacts on fishing due to the east-west alignment with adjacent projects and wider WTG spacing, the overall cumulative impacts of Alternative D1 and Alternative D2 on commercial fisheries and for-hire recreational fishing would likely be very similar to those of the Proposed Action as discussed in the preceding paragraphs with individual IPFs leading to impacts ranging from **negligible** to **major**. The overall cumulative impacts of Alternative D1 when combined with the past, present, and reasonably foreseeable activities would result in **major** impacts on commercial fisheries and for-hire recreational fishing. The overall cumulative impacts of Alternative D2 when combined with the past, present, and reasonably foreseeable activities would result in **major** impacts on commercial fisheries and for-hire recreational fishing. While some impacts would be reduced under Alternative D2 due to the uniform 1x1-nautical-mile WTG spacing with east-west/north-south orientation, the overall rating would remain **major**. This impact rating is driven mostly by changes to fish distribution/availability due to climate change, reduced stock levels due to fishing mortality, and permanent impacts due to the presence of structures (cable protection measures and foundations).

3.11.2.5. Cumulative Impacts of Alternative E

As discussed in the Draft EIS Section 3.4.5.8, the direct and indirect impacts under Alternative E would be slightly less than those of the Proposed Action. Compared to the Proposed Action, Alternative E would improve access to certain fishing locations and increase the ability of vessels to deploy fishing gear where the 16 WTGs are removed, but such impacts would be limited to those locations. Due to the reduced number of WTGs, Alternative E could also reduce the risk of allisions and collisions between the proposed Project-related vessels and fishing vessels, and would decrease the likelihood of damage or loss of deployed gear. IPFs associated with the installation of no more than 84 WTGs, including pile driving, would be reduced by approximately 16 percent compared to the maximum impact scenario under the Proposed Action, namely 100 WTGs; however, the overall impact on the resource would be a similar level to that of the Proposed Action (**moderate** impacts on commercial fisheries for-hire recreational fishing).

Although BOEM expects Alternative E would have reduced impacts on commercial fisheries due to less structure to impede transit and fishing, the overall cumulative impacts of Alternative E on commercial fisheries would likely be very similar to those of the Proposed Action as discussed in the preceding paragraphs with individual IPFs leading to impacts ranging from **negligible** to **major**. The overall cumulative impacts of Alternative E when combined with the past, present, and reasonably foreseeable activities would result in **major** impacts on commercial fisheries and for-hire recreational fishing. This impact rating is drive mostly by changes to fish distribution/availability due to climate change, reduced stock levels due to fishing mortality, and permanent impacts due to the presence of structures (cable protection measures and foundations).

3.11.2.6. Direct, Indirect, and Cumulative Impacts of Alternative F

Alternative F would provide space for a vessel transit lane through the WDA, in which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. Under this alternative, BOEM is analyzing a 2-nautical-mile or a 4-nautical-mile northwest/southeast vessel transit lane through the WDA combined with any action alternative; however, this analysis focuses on the combination of Alternative F with either the Proposed Action or Alternative D2 layout. A minimum 4-nautical-mile transit lane was proposed by RODA in their (January 3, 2020) letter to BOEM requesting the analysis of this alternative and is reflective of opinions expressed by fishermen in a series of transit workshops between September and December 2018. At those same workshops offshore wind lessees expressed that 2 miles was a sufficient corridor width for safe navigation and lease area development (Consensus Building Institute 2018). As described in Chapter 2, BOEM assumes that in order for the proposed Project to maintain the contracted energy supply, the WTGs (and possibly an ESP) that would have been located within the transit lane would be shifted south within the lease area, while the total number of foundations would remain the same. An increase in the size of the WDA would require the completion of additional pre-construction surveys, expanding on those already completed for the WDA. This work would be completed prior to construction activities and would consist of biological, geological, and geotechnical surveys. As the WDA would expand in the southern portion of the Vineyard Wind lease area, additional surveys could result in increased vessel activity in that area prior to construction activities, causing **minor** disruptions to fishing activities.

The impacts from the combination of Alternative F with Alternatives B, C, D1, D2, and E are expected to be similar to the combination with the Proposed Action. Alternative B would not change the layout of the Proposed Action's WTGs and would only utilize the Covell's Beach landfall. Alternative C would shift the six northernmost WTG positions to the southern portion of the WDA, but would not change the WTG layout in the portion of the WDA affected by the northern transit lane under Alternative F. While Alternative D1 would result in wider spacing between WTGs in comparison to the Proposed Action, this increased spacing would not meaningfully change the IPFs described above for Alternative F in combination with the Proposed Action. While Alternative D2 would result in wider spacing between WTGs and an east-west/north-south orientation in comparison to the Proposed Action, this increased spacing and orientation would not meaningfully change the IPFs described above for Alternative F in combination with the Proposed Action. Alternative E would result in fewer WTGs in the WDA (compared to the Proposed Action) and thus a smaller WDA, but would not affect WTG spacing.

As a result, while the direct impacts of IPFs associated with Alternative F, combined with Alternatives B, C, D1, D2 and E could differ from those of Alternative F combined with the Proposed Action, these impacts would still have overall **moderate** direct and indirect impacts on commercial fisheries and on for-hire recreational fishing.

The primary differences between the Proposed Action and the combination of Alternative F and the Proposed Action would be the establishment of an up to 4-nautical-mile-wide transit lane through the WDA. The northern transit lane within the WDA could result in the relocation of 16 to 34 WTG placements outside the proposed transit lane, an increased extent of inter-array cables, and a 12 to 61 percent increase in the size of the WDA and an increased length of inter-array cables (depending on whether the Proposed Action or Alternative D2 layout is used and how wide the transit lane is). The establishment of a 2- or 4-nautical-mile-wide transit lane is intended to improve transit of fishing vessels through the Vineyard WDA from southern New England, primarily New Bedford, Point Judith, and Stonington to fishing areas on Georges Bank, which is demonstrated in the VMS-based polar histograms (Figures 3.11-1 to 3.11-6). Alternative F with the Alternative D2 layout might increase adverse impacts on safe vessel movement and navigation as a whole by adding choke points and funneling navigation. Section 3.13.2.4 includes further discussion on impacts on navigation. While this alternative may increase unobstructed space within the transit lane, which fishing could occur within, it is not likely to improve fishing opportunities that use a different orientation (along bathymetric contours). Expanding the WDA and shifting some activities and structures to the south/southwest would likely not impact the accessibility to/availability of fish within the Vineyard WDA, beyond the impacts of the Proposed Action, since the number of turbines would remain the same and fishing would not be restricted within the transit lane. However, the northwest/southeast orientation of the lane does not match the predominant fishing patterns in the area (Figure 3.11-1). The addition of a transit lane could also lead to increased conflict between fishermen, if they concentrate both fishing and transit activity. There would be no restrictions on setting fixed gear in the transit lanes however, fixed gear fishermen may choose not to set gear in the transit lanes due to the greater potential for loss or damage to gear from a higher volume of transiting vessels than would occur under Alternative D2 or the Proposed Action. The length of inter-array cabling would increase and would be up to 234 miles (376 kilometers) exceeding the maximum design parameter in the COP PDE of 171 miles (275 kilometers) due to the need to traverse a 2-nautical-mile or 4-nautical-mile transit lane. The cables within the WDA would likely not require cable protection measures, but there could still be temporary impacts on fishing vessel activities during cable emplacement and maintenance. The direct and indirect impacts of Alternative F on commercial fisheries and for-hire recreational fishing would be a similar level to those of the Proposed Action (**moderate** impacts on commercial fisheries and for-hire recreational fishing), but slightly less due to an improvement in navigation and a slight improvement in fishing opportunity.

In considering the cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities, BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The cumulative impacts of Alternative F would vary depending upon if it was selected with the Proposed Action or Alternative D2 layout. Alternative F combined with any other alternative would generally facilitate transit, but not improve fishing due to the orientation of the transit lanes. Thus, while navigation to other fishing grounds outside offshore wind energy project areas may be improved, impacts on fishing within project areas may only marginally improve. The overall cumulative impacts of Alternative F in combination with the Proposed Action and any action alternative on commercial fisheries would likely be very similar to those of the Proposed Action as discussed in the preceding paragraphs with individual IPFs leading to impacts ranging from **negligible** to **major**. The overall cumulative impacts of Alternative F in combination with the Proposed Action and any action alternative when combined with the past, present, and reasonably foreseeable activities would result in **major** impacts on commercial fisheries and for-hire recreational fishing. While Alternative F in combination with the Alternative D2 layout has a lower impact rating for vessel navigational hazards due to the uniform 1x1-nautical-mile WTG spacing with east-west/north-south orientation, the overall impact rating remains **major**. This impact rating is driven mostly by changes to fish distribution/availability due to climate change, reduced stock levels due to fishing mortality, and permanent impacts due to the presence of structures (cable protection measures and foundations).

BOEM has qualitatively evaluated the cumulative impacts of implementing all six RODA-recommended transit lanes, including the northern transit lane described for Alternative F, as well as five other transit lanes through the RI and MA Lease Areas. To the extent additional transit lanes are implemented in the future outside of the WDA as part of RODA's suggestion, the WTGs for future offshore wind projects may need to be located further from shore, similar to the proposed Project under Alternative F. As a result, establishment of these additional transit lanes could result in potentially more fishing opportunity within the transit lanes, improved fishing vessel navigation, and cable-related impacts; however, it could also lead to increased conflict between fishermen due to the orientation of the transit lanes not matching the east-west fishing orientation and increased impacts on vessel movement and navigation by adding choke points and funneling navigation. If all the proposed transit lanes were implemented, one or more reasonably foreseeable offshore wind projects may not be able to deliver the expected power generation capacity and/or may no longer be commercially viable because WTGs would not be placed in the area designated by the transit lanes. As a result, the technical capacity of offshore wind power generation assumed in Chapter 1 would not be met. Specifically, assuming that all WTGs would be of 12 MW capacity, then an estimated 800 foundations (784 WTGs and 16 ESPs) within the RI and MA Lease Areas would be required to meet the offshore energy demand.[12] Cumulatively, implementation of all six transit lanes with a 4-nautical-mile transit lane and a 1x1-nautical-mile WTG layout would only allow space for a maximum of 736 foundations. Therefore, the total number of foundations and WTGs expected in the cumulative scenario would decrease. However, as with the incremental impacts of the proposed Project under Alternative F, the other projects intersected by transit lanes may also require a larger WDA and an increased amount of cable, leading to potentially more fishing opportunity within the transit lanes, improved fishing vessel navigation, and cable-related impacts under this scenario than in the absence of the transit lanes. It could also lead to increased conflict between fishermen due to the orientation of the transit lanes not matching the east-west fishing orientation and increased impacts on vessel movement and navigation by adding choke points and funneling navigation. Section 3.13.2.6 includes further discussion on impacts on navigation. If in the future all six transit lanes were implemented with 2-nautical-mile transit lanes and/or with the Proposed Action layout there may not be enough space to develop power generation capacity to meet demand in Massachusetts, Rhode Island, and New York. Therefore, cumulative impacts under this scenario would likely fall somewhere between the cumulative impacts of the Proposed Action (or of Alternative D2) and the cumulative impacts of Alternative F with 4-nautical-mile transit lane and the Alternative D2 layout. The proposed transit lanes would not intersect any wind energy area outside the RI and MA Lease Areas.

3.11.2.7. Comparison of Alternatives

As discussed in the Draft EIS Section 3.4.5.10, the direct and indirect impacts associated with the Proposed Action do not change substantially under Alternatives B through E. While the alternatives could slightly change the impacts on commercial fisheries and for-hire recreational fishing within the WDA and there would be incremental beneficial and adverse effects for various users for a number of the alternatives, ultimately, the same construction, operations and maintenance, and decommissioning activities would still occur, albeit at a reduced scale in some cases. BOEM developed Alternatives B, C, D, E, and F in an attempt to reduce conflicts with commercial fishing. There appear to be benefits to commercial fisheries and for-hire recreational fishing from avoiding disruption in Lewis Bay (Alternative B), maintaining a minimum spacing of 1 nautical mile between WTGs (Alternative D1), using an east-west

[12] If the WTG sizes specified in Appendix A are assumed, a total of 975 foundations would be required for the RI and MA Lease Areas.

layout orientation (Alternate D2), the removal of surface occupancy in the northern/northeastern-most portion of the WDA (Alternative C), reduced proposed Project size (Alternative E), and implementing a northwest/southeast vessel transit lane (Alternative F). Also, while Alternative E would reduce the overall number of WTGs from 100 to 84, thus reducing the Project's footprint, the layout of Alternative D2 (east-west with 1 nautical mile between turbines) and vessel transit lane of Alternative F would be expected to further reduce potential impacts from structures from fishing and fishing vessel transits. Alternative D2 is the alternative preferred by the Rhode Island Coastal Resources Management Council. However, BOEM expects that impacts from cable emplacement and maintenance would increase with the increased distance between turbines (Alternatives D1 and D2 with and without Alternative F). Overall, the advantages of the different alternatives over the Proposed Action are limited, and any action alternative would still have a similar overall level of direct and indirect moderate impacts on commercial fisheries and for-hire recreational fishing.

Cumulative impacts under any action alternative would likely be similar because the majority of the cumulative impacts of any alternative come from other future offshore wind development, which does not change between alternatives, and because the differences in direct and indirect impacts between action alternatives would not result in different direct and indirect impact magnitudes..

Several of the action alternatives to the Proposed Action convey slight benefits to fishing, fishing vessel transit, or both. The selection of individual alternatives or combination of alternatives would benefit different fisheries, primarily those that fish in, or transit, the lease areas offshore of Rhode Island and Massachusetts. However, the cumulative impact assessment considers all fisheries and commercial offshore wind projects from Cape Hatteras to the Gulf of Maine. As a result of this cumulative analysis there is not a single alternative or combination of alternatives that substantially reduces the impacts to cause a reduction in the impact rating. Thus the cumulative impacts of all alternatives would be very similar to those of the Proposed Action as discussed in the preceding paragraphs with individual IPFs leading to impacts ranging from negligible to major. The overall cumulative impacts of any alternative when combined with past, present, and reasonably foreseeable activities on commercial fisheries and for-hire recreational fishing would be major. This impact rating is driven mostly by changes to fish distribution/availability due to climate change, reduced stock levels due to fishing mortality, and permanent impacts due to the presence of structures (cable protection measures and foundations).

3.12. Land Use and Coastal Infrastructure

3.12.1. No Action Alternative Impacts

Table 3.12-1 contains a detailed summary of baseline conditions and the impacts of ongoing and future offshore activities other than offshore wind on land use and coastal infrastructure, based on the IPFs assessed. This information primarily comes from the Draft EIS, supplemented by information developed in responding to comments on the Draft EIS and additional information. The impact analysis is limited to impacts within the geographic analysis area for land use and coastal infrastructure as described in Table A-1 and shown on Figure A.7-11. Specifically, this includes the towns of Barnstable and Yarmouth, and ports potentially used for the proposed Project's construction and installation, operations and maintenance, and decommissioning.

Land use and coastal infrastructure is diverse and widespread within the geographic analysis area due to the presence of large coastal population centers, as well as recreational, tourism, residential, commercial, and industrial development (NOAA 2010). The amount of developed land in NOAA's Northeast Coastal Region (which includes the geographic analysis area) increased from 1996 to 2010. Approximately 9 percent of this land area is developed, with development highly concentrated around high-intensity development urban areas (NOAA 2010).

The towns of Barnstable, Yarmouth, and Tisbury are long-established communities with a mix of low- to medium-density residential development, business areas, extensive recreation or tourist-oriented commercial and public uses, open space, and smaller areas of industrial use. Challenges facing the Cape Cod region include an inadequate housing supply for the region's low and moderate income residents; limited infrastructure; loss of forest cover; use of on-site septic systems that do not adequately protect water quality; climate change; and lack of protection for historic buildings (Cape Cod Commission 2018).

The city of New Bedford is a densely developed, historic manufacturing town and port. The city's Master Plan establishes numerous goals, which include developing emerging technology industry sectors, linking brownfields and historic mills with new development opportunities, diversifying the industries in the Port of New Bedford while supporting traditional harbor industries, and promoting sustainable, mixed-use development in neighborhoods (Vanasse Hangen Brustlin, Inc. 2010).

The town or community plans for Barnstable, Yarmouth, and Martha's Vineyard place priority on protection of community character and conservation of natural resources, and recommend no substantial changes in land uses near proposed Project onshore facilities (Town of Barnstable 2010; Yarmouth Department of Community Development 1998; Martha's Vineyard Commission 2010). The Martha's Vineyard plan notes a decline in the commercial fishing industry and calls for protecting harbor facilities for commercial fishing, including harbors in Tisbury and other towns on the island (Martha's Vineyard Commission 2010). The 2018 Cape Cod Regional Policy Plan (which covers Barnstable and Yarmouth) calls for fostering a diverse mix of business and industry, encouraging industries that provide living wage jobs, expanding economic activity and promoting year-round, diverse housing stock while preserving the region's natural, cultural, and historic resources (Cape Cod Commission 2018).

Land use and coastal infrastructure in the geographic analysis area are subject to pressure from ongoing activities, especially onshore and coastal development projects and port expansion. Most onshore activities would only occur where permitted by local land use authorities, which would avoid long-term land use conflicts.

Under the No Action Alternative, the proposed Project would not be built and hence would have no land use and coastal infrastructure impact. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. If the Vineyard Wind 1 Project is not approved, then impacts from the proposed Project would not occur as proposed. However, the state demand that the Vineyard Wind 1 Project would have filled, if approved, could likely be met by other projects in the geographic analysis area for land use and coastal infrastructure. Therefore, the impacts on land use and coastal infrastructure would be similar, but the exact impact 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 and considers the assumptions included in Section 1.2 and Appendix A. A detailed analysis of impacts associated with future offshore wind development is provided in Section 3.12.1.1 and summarized in Table 3.12-1. Cumulative impacts of the Proposed Action and action alternatives are analyzed in Section 3.12.2.

3.12.1.1. Future Offshore Wind Activities (without Proposed Action)

Considering the limited extent of the geographic analysis area for land use and coastal infrastructure, only a small subset of potential future offshore wind activities have the possibility of influencing conditions within the geographic analysis area. Given the locations of RI and MA Lease Areas and COPs or other announced plans for offshore export cable routes, the only future offshore wind activities (other than the Proposed Action) that could intersect the geographic analysis area are Vineyard Wind 2 (OCS-A 0501 [southern portion]), Mayflower Wind (OCS-A 0521), possibly a development by Equinor Wind US (OCS-A 0520), and Bay State Wind (OCS-A 0500). Port activities and onshore cables from these activities may occur in or near the geographic analysis area. However, the exact extent of impacts will depend on locations of landfall, length of cable routes, nearby resources, and ports utilized to support the future offshore wind activities. BOEM expects these future offshore wind development activities to affect land use and coastal infrastructure through the following primary IPFs.

Accidental releases: Accidental releases of fuel/fluids/hazmat may increase as a result of future offshore wind activities. See Section A.8.2 for a discussion of the nature of anticipated releases. The risk of accidental releases would be increased primarily during construction, but also during operation and decommissioning of offshore wind facilities. BOEM assumes all projects and activities would comply with laws and regulations to minimize releases. The overall impact of accidental releases on land use and coastal infrastructure is anticipated to be localized, short-term, and could result in temporary restriction on use of adjacent properties and coastal infrastructure during the cleanup process. The exact extent of impacts would depend on the locations of landfall, substations, and cable routes, as well as the ports utilized to support future offshore wind energy projects. Based on the discussion in Section A.8.2, the impacts of accidental releases on land use and coastal infrastructure would be localized and short-term (except in the case of very large spills that affect a large land or coastal area).

Light: The permanent aviation warning lighting required for offshore wind WTGs would be visible from some beaches and coastlines and could have indirect effects on land use through direct impacts on recreation, tourism, and property values in certain locations if the lighting influences visitors in selecting coastal locations to visit or buy. As stated in Section 3.10, aviation hazard lighting from approximately 709 WTGs (out of 775) could potentially be visible from beaches and coastal areas in the geographic analysis area for land use and coastal infrastructure. Visibility would depend upon distance from shore, topography, and atmospheric conditions, but would generally be localized, constant, and long-term. If implemented, ADLS (as described in Draft EIS Section 3.4.1.3) would activate the aviation warning lighting when aircraft approach WTGs. For the Proposed Action, this is expected to occur less than 0.1 percent of annual nighttime hours. Similar analyses have not been prepared for other offshore wind projects; however, this SEIS assumes that activation of ADLS (if used) for other projects would be comparably rare. This would reduce the land use impacts already associated with WTG lighting.

Lighting from substations could also affect the ability to use nearby properties or decisions about where to establish permanent or temporary residences. It is likely that other projects like the proposed Vineyard Wind 1 Project would expand or construct new substations near existing substations, or would construct new substations in areas where land development regulations (i.e., zoning and land use plan designations) allow such uses. For new or expanded substations in business or industrial areas, lighting would have no adverse impacts on land uses. The extent of lighting impacts would depend on the proposed substation locations, but would generally be localized, constant, and long-term.

Port utilization: Future offshore wind activity could necessitate port expansion in Massachusetts and Rhode Island. Offshore wind energy projects would make productive use of port facilities for shipping, berthing, and staging throughout construction, operations, and decommissioning, including use of the MCT at the Port of New Bedford, which was developed as a result of state investment to support the offshore wind industry. Offshore wind would likely increase port utilization, and ports would experience beneficial impacts such as greater economic activity and increased employment due to demand for vessel maintenance services and related supplies, vessel berthing, loading and unloading, warehousing and fabrication facilities for offshore wind components, and other business activity related to offshore wind. The Massachusetts Clean Energy Center has identified 18 waterfront sites in Massachusetts—of which 8 are in the New Bedford area, with the remaining 10 being outside the geographic analysis area—that may be available and suitable for use by the offshore wind energy industry, including retired waterfront power plant sites (MassCEC 2017a). If multiple future offshore wind energy projects are constructed at the same time and rely on the same ports, this simultaneous use could stress port resources and could potentially increase the marine and road traffic, noise, and air pollution in the area. Overall, the No Action Alternative would have constant, long-term, beneficial impacts on port utilization due to the productive use of ports designated for offshore wind activity; as well as localized, short-term, adverse impacts in cases where individual ports are stressed due to simultaneous project activity.

Presence of structures: During operations, the views of offshore wind WTGs from coastal locations on Martha's Vineyard, Nantucket and mainland Cape Cod could have indirect effects on land use, through direct impacts on recreation, tourism, and property values, if the views influence visitors in selecting coastal locations to visit or buy. Based upon the currently available studies, portions of all 775 WTGs associated with the No Action Alternative could be visible from some shorelines (depending on vegetation, topography, and atmospheric conditions), of which up to 34 (fewer than 5 percent) would be within 15 miles (24.1 kilometers) of shore. As stated in Section 3.10, while WTGs could be visible from some shoreline locations in the geographic analysis area, WTGs would not dominate offshore views, even when weather and atmospheric conditions allow views. Visibility would vary with distance from shore, topography, and atmospheric conditions and would generally be localized, constant, and long-term.

The presence of onshore transmission cable infrastructure is anticipated to have minimal long-term impacts on land use. As stated above, this analysis assumes that new substations for future offshore wind projects would be within or near existing substations, or in locations designated for such uses. This analysis further assumes that cable conduits would primarily be underground and collocated with roads and/or other utilities. As a result, operation of substations and cable conduits would not affect the established and planned land uses for a local area.

Land disturbance: Future offshore wind installation would require installation of onshore transmission cable infrastructure, which would cause temporary traffic delays and could temporarily affect access to adjacent properties. 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 future offshore wind energy projects; however, the No Action Alternative would generally have localized, short-term impacts during construction or maintenance and no long-term impacts on land use.

3.12.1.2. Conclusions

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impacts on land use and coastal infrastructure. BOEM expects ongoing activities and future offshore wind activities to affect land use and coastal infrastructure, primarily through the IPFs related to accidental releases, light, port utilization, the presence of structures, and land disturbance.

Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in overall minor adverse impacts, primarily through land disturbance, accidental releases, and light. Future offshore wind would adversely affect land use directly through installation of onshore cable routes and accidental releases during onshore construction, and indirectly through the presence of offshore wind-related lighting that could affect the use and value of onshore properties. Section A.8.2 discusses the impacts of accidental releases, while Section 3.10 discusses the visual impacts of wind energy lighting.

BOEM also anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in overall minor beneficial impacts because development of offshore wind activities (excluding the Project) in the geographic analysis area would require the productive use of ports designated or appropriate for future offshore wind activity (including construction and installation, operations and maintenance, and decommissioning).

In addition to the IPFs related to offshore wind described above, IPFs related to non-offshore wind would also affect land use and coastal infrastructure. Increases in marine navigation and fishing would increase the use of onshore infrastructure and port facilities. Onshore development projects, such as the Village at Barnstable (Hyannis, Massachusetts) and manufacturing, commercial, and retail development projects would also impact land use and coastal infrastructure within the geographic analysis area. The discussion above notwithstanding, changes in land use and coastal infrastructure in the geographic analysis area would generally continue to follow current regional trends and respond to current and future environmental and societal activities.

3.12.2. Proposed Action and Action Alternatives

3.12.2.1. Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on land use and coastal infrastructure were described in the Draft EIS Section 3.4.6.3, and additional information is included in Table 3.12-1. The Proposed Action would likely result in local impacts that would not alter the overall character of land use and coastal infrastructure in the geographic analysis area. The Proposed Action would contribute to impacts through all the IPFs listed in Section 3.12.1.1. The most impactful IPFs would likely include land disturbance during cable installation, which could cause temporary traffic delays and public beach disturbance during onshore cable installation lasting a few days to weeks, and the utilization of ports, which would lead to a beneficial impact. (The Proposed Action would not itself require port upgrades, but would make productive use of ports that have been upgraded or are planned for upgrade for the offshore wind industry overall). Other IPFs would likely contribute impacts of lesser intensity and extent, and would occur primarily during construction, but also during operations and decommissioning.

The Draft EIS did not contemplate lighting or the visual impacts of WTGs as IPFs affecting land use and coastal infrastructure. WTGs as well as offshore construction and operational lighting could potentially be visible from higher elevations and some locations on the coastline of Cape Cod, Martha's Vineyard, and Nantucket (depending on topography, vegetation, weather, and atmospheric conditions). Aviation hazard lights on WTGs would operate continuously at night, although the proposed Project may use ADLS hazard lighting if approved, as described below. Onshore nighttime lighting for operation of the substation, in an industrially zoned area of Barnstable, would be appropriate for the land use setting.

Changes to the design capacity of the turbine to be used would not alter the maximum potential impacts on land use and coastal infrastructure for the Proposed Action and all other action alternatives because the maximum-case scenario involved the maximum number of WTGs allowed in the PDE. Increasing the size of the proposed substation by 2.2 acres (less than 0.1 km^2), as described in Chapter 2, would not change the analysis of impacts on land use and coastal infrastructure for the Proposed Action and all other action alternatives included in the Draft EIS because the additional affected area would be adjacent to an existing substation and within industrially zoned land.

The cumulative impacts of the Proposed Action, in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities, are listed by IPF in Table 3.12-1.

Accidental releases: As stated in Draft EIS Section 3.2.2.3, accidental releases from the Proposed Action would have negligible to minor impacts on water resources. As a result, accidental releases would also have localized, short-term, **negligible** to **minor** impacts on land use. The Proposed Action would incrementally increase the cumulative risk of (and thus the potential impacts from) accidental releases of fuel/fluids/hazmat in the geographic analysis area for land use and coastal infrastructure. Cumulatively, the Proposed Action, in combination with past, present, and reasonably foreseeable activities would have localized, short-term, **negligible** to **minor** cumulative impacts on land use and coastal infrastructure.

Light: Construction of the Proposed Action could require temporary nighttime lighting during construction and decommissioning of the WTGs in the WDA, and during cable installation along the OECC. In addition, the Proposed Action would include the installation and continuous nighttime use of aviation hazard avoidance lighting on WTGs and ESPs. Visibility of nighttime lighting during construction and decommissioning would be limited to the southern coasts and some elevated areas of Martha's Vineyard, Nantucket, and adjacent islands, and would depend on vegetation, topography, weather, and atmospheric conditions. As described in Section 3.10, during operations, lighting from all the Proposed Action's WTGs could potentially be visible from certain coastal and elevated locations on Martha's Vineyard and Nantucket. Vineyard Wind has committed to voluntarily implement ADLS (as described in Draft EIS Section 3.4.1.3), which would activate the Proposed Action's WTG lighting when aircraft approach the Vineyard Wind 1 Project WTGs, which is expected to occur less than 0.1 percent of annual nighttime hours. As a result, WTG lighting would have an indirect, long-term, continuous, **negligible** impact on land use and coastal infrastructure in the geographic analysis area, due to potential effects on property use and value.

The proposed substation would include new lighting, which could affect the ability to use existing properties within sight of this lighting, as well as decisions about where to establish permanent or temporary residences. Because the proposed substation would be constructed adjacent to an existing substation, in an industrially zoned area of Barnstable, the substation lighting impacts on land use and coastal infrastructure are expected to be *de minimis*.

As stated in Section 3.7.1, offshore nighttime construction lighting and operational aviation hazard lighting for up to 709 WTGs (out of 775) associated with the Proposed Action and No Action Alternative projects could be visible from shore (depending on vegetation, topography, weather, and atmospheric conditions). The indirect land use impacts from the Proposed Action in combination with the No Action Alternative would be similar to, but more extensive than, the impacts for the Proposed Action alone, as discussed in Draft EIS Section 3.4.6.3. Nevertheless, the Proposed Action's WTG lighting, in combination with the No Action Alternative, would have continuous, long-term, **negligible** cumulative impacts on land use and coastal infrastructure. If implemented for future offshore wind projects similar to the Proposed Action, ADLS would reduce the already **negligible** land use impacts associated with WTG lighting.

Port utilization: Future offshore wind development would support investment and employment related to use and expansion of ports and supporting industries in Rhode Island and Massachusetts, including several ports indicated as possibly supporting Vineyard Wind 1 Project construction: the ports of New Bedford, Montaup, and Brayton Point in Bristol County, ProvPort in Providence County and the Port of Davisville (Quonset Point) in Washington County. The Proposed Action includes no port expansion activities, but would use ports that have expanded or would expand to support the wind energy industry generally, including the MCT in New Bedford (for construction and installation) and the Vineyard Haven Harbor on Martha's Vineyard (for the proposed Operations and Maintenance Facility). As described in Draft EIS Section 3.4.6.3, the Proposed Action would have localized short-term (at the MCT) or long-term (at Vineyard Haven), **negligible beneficial** impacts on land use and coastal infrastructure. As a result, the Proposed Action's port usage, in combination with port usage for the No Action Alternative, would have short-term (at the MCT) or long-term (at Vineyard Haven), **minor beneficial** cumulative impacts on land use and coastal infrastructure.

Presence of structures: Portions of all Proposed Action WTGs could be visible from southern coasts and elevated areas of Martha's Vineyard, Nantucket, adjacent islands, and the Cape Cod mainland, depending upon vegetation, topography, and atmospheric conditions. As stated in Section 3.10, most WTGs would be more than 15 miles (24.1 kilometers) from the coastal viewers and the WTGs would not dominate offshore views, even when weather and atmospheric conditions allow views. Views of WTGs would have a long-term, continuous, **negligible**, indirect impact on land use and coastal infrastructure in the geographic analysis area, due to potential effects on property use and value.

During operations, the cumulative visual impacts of the WTGs visible from southern coastlines and elevated inland locations could have indirect, long-term impacts on land use if the views influence visitor decisions on locations or properties to visit or purchase. Portions of up to 775 WTGs from the Proposed Action and No Action Alternative could potentially be visible from coastal and elevated locations in the geographic analysis area. As noted in Section 3.10, impacts on recreation and tourism activities would be moderate, and the associated cumulative impacts on land use are anticipated to be localized, long-term, and **minor.**

The presence during operations of the Proposed Action's onshore transmission cable infrastructure would have no impacts on land use except during occasional repairs; the cable conduits would be underground and located within existing ROW, and the substation would be within an industrial area adjacent to an existing substation. Impacts on land use would be long-term and **negligible**. Cumulatively, the presence of onshore transmission cable infrastructure associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities is anticipated to have **negligible** impacts on land use. Assuming that new substations for future offshore wind projects would be in locations designated for industrial or utility uses, and underground cable conduits would primarily be collocated with roads or other utilities, operation of substations and cable conduits would not affect the established and planned land uses for a local area.

Land disturbance: The Proposed Action's onshore transmission cable infrastructure would be installed entirely underground in a ductbank, generally along, under, or adjacent to existing roads or utility ROW. This IPF would not change adjacent land uses or affect coastal infrastructure, but construction or maintenance activity would cause temporary traffic delays and temporarily impact access to properties adjacent to active construction and occasional maintenance sites. The Proposed Action is considering two different landfall sites and two different OECRs, which could change the extent of the inconvenience and disruption from installation activities. The eastern OECR (using the Covell's Beach landfall) would be approximately 5.4 miles (8.9 kilometers) while the western

OECR (using the New Hampshire Avenue landfall) would be approximately 6.1 miles (9.8 kilometers). Vineyard Wind would work with the town of Barnstable and/or Yarmouth (depending on the cable landfall site and OECR chosen) to develop a Traffic Management Plan to minimize disruptions to nearby land uses during construction activities (Epsilon 2018a). Construction and installation of the Proposed Action's OECR using Covell's Beach would have localized, short-term, **minor** impacts on land use due to temporary access restrictions along the OECR route; however, the New Hampshire Avenue would have **moderate** impacts due to the disruption to a public parking lot, beach, boat ramp, and nearby residences.

The short-term impacts on land use and coastal infrastructure would be cumulative only if land disturbance associated with one or more other projects occurs in close spatial and temporal proximity. In such cases, the Proposed Action in combination with the No Action Alternative would have a localized, short-term, **minor** to **moderate** cumulative impact on land use and coastal infrastructure due to construction-related disturbance and access limitations along OECR routes.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from **negligible** to **moderate** impacts and **negligible** to **minor beneficial** impacts. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in **minor** impacts and **minor beneficial** impacts on land use in the geographic analysis area. The main drivers for this impact rating include **minor** impacts and **minor beneficial** cumulative impacts associated with port utilization, the presence of onshore structures and land disturbance as discussed in Section 3.12.2.1. The Proposed Action would contribute to the overall impact rating primarily through short-term impacts from onshore landfall, cable and substation installation, as well as beneficial impacts due to the use of port facilities designated for offshore wind activity. BOEM has considered the possibility of a **moderate** impact that is anticipated during construction due to the temporary disruption of land uses at the landfall site, but these impacts would be short-term and occur only if the New Hampshire Avenue landfall site is selected. Thus, the overall cumulative impacts on land use would likely qualify as **minor**, because it is expected that the disruption associated with construction would be short-term and land uses would revert to pre-construction conditions upon completion of construction. There would also be **minor beneficial** cumulative impacts on land use, due to a small and measurable benefit from construction and operations-phase utilization of port facilities.

3.12.2.2. Cumulative Impacts of Alternative B

The direct and indirect impacts of Alternative B on land use and coastal infrastructure are described in Draft EIS Section 3.4.6.4. Alternative B would narrow the PDE to include only the Covell's Beach landfall. The change in landfall location would not change the overall impact on land use and coastal infrastructure, although Alternative B would avoid impacts on Englewood Beach, the public boat ramp and parking lot, and residences near the New Hampshire Avenue landing site. The direct and indirect impacts resulting from individual IPFs associated with Alternative B on land use and coastal infrastructure would be similar to the Proposed Action: **negligible** to **minor beneficial** impacts at ports, and **negligible** to **minor** impacts for the onshore infrastructure.

The cumulative impacts of Alternative B would be lower than those of the Proposed Action because of the avoidance of impacts at the New Hampshire Avenue landfall site, with individual IPFs leading to impacts ranging from **negligible** to **minor** impacts and **negligible** to **minor beneficial** impacts. The overall cumulative impact of Alternative B when combined with past, present, and reasonably foreseeable activities would be very similar to those of the Proposed Action—**minor** impacts and **minor beneficial** impacts. The impact rating is primarily driven by impacts from views of offshore structures, the installation of onshore infrastructure, and port utilization.

3.12.2.3. Cumulative Impacts of Alternatives C, D1, D2, and E

The direct and indirect impacts of Alternatives C, D1, D2, and E on land use and coastal infrastructure are described in Draft EIS Section 3.4.6.5. As discussed there, the incremental and cumulative impacts of these alternatives would be similar to those of the Proposed Action. The direct and indirect impacts resulting from individual IPFs associated with Alternatives C, D1, D2, and E on land use and coastal infrastructure would be the same as the Proposed Action: **negligible** to **minor beneficial** impacts at ports, and **negligible** to **moderate** impacts for the onshore infrastructure.

The cumulative impacts of Alternatives C, D1, D2, and E would be very similar to those of the Proposed Action, as discussed above, with individual IPFs leading to impacts ranging from **negligible** to **moderate** impacts on land use along with **negligible** to **minor beneficial** impacts due to port utilization. The majority of the cumulative impacts come from future offshore wind projects, and the direct and indirect impacts of this alternative would be very similar to those of the Proposed Action. The overall cumulative impacts of Alternatives C, D1, and D2 when combined with past, present, and reasonably foreseeable activities on land use would be very similar to those of the Proposed Action—**minor** impacts and **minor beneficial.** This impact rating is primarily driven by impacts from views of offshore structures, the installation of onshore infrastructure and port utilization.

3.12.2.4. Direct, Indirect, and Cumulative Impacts of Alternative F

Alternative F analyzes a vessel transit lane through the WDA, in which no surface occupancy would occur. This alternative would affect onshore components of the proposed Project similarly to the Proposed Action, and it would affect IPFs related to land use and coastal infrastructure similarly to the Proposed Action as well. As a result, Alternative F would have similar direct and indirect impacts resulting from individual IPFs on land use and coastal infrastructure as the Proposed Action, i.e., **negligible** to **moderate** adverse impacts on land use and coastal infrastructure along with **negligible** to **minor beneficial** impacts due to active use of port facilities designated for offshore wind.

The cumulative impacts resulting from individual IPFs associated with Alternative F, when combined with past, present, and reasonably foreseeable activities, would be very similar to those of the Proposed Action—**negligible** to **moderate** impacts on land use along with **negligible** to **minor beneficial** impacts due to port utilization; the majority of the cumulative impacts would come from future offshore wind projects, and the direct and indirect impacts of this alternative would be very similar to those of the Proposed

Action. The overall cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities on land use within the geographic analysis area would be of the same level as the Proposed Action—**minor** impacts and **minor beneficial**. This impact rating is primarily driven by impacts from views of offshore structures, installation of onshore infrastructure and port utilization.

3.12.2.5. Comparison of Alternatives

As discussed in Draft EIS Section 3.4.6.7, the direct and indirect impacts associated with the Proposed Action would not change substantially under Alternatives B through E. The same construction, operations and maintenance, and decommissioning activities would still occur for each of the alternatives. Alternative B, which specifies the Covell's Beach landfall site, would avoid impacts on Englewood Beach, the nearby public boat ramp and parking lot, and nearby residences, and would have lower magnitude impacts on land use and coastal infrastructure. In other respects, the direct and indirect impacts of alternatives on land use and coastal infrastructure would be similar. Therefore, the overall level of direct and indirect impacts would be very similar across all alternatives—**negligible** to **moderate** (**minor** for Alternative B) impacts on land use and coastal infrastructure along with **negligible** to **minor** beneficial impacts due to active use of port facilities designated for offshore wind.

Cumulative impacts under any action alternative would be very similar because the majority of the cumulative impacts on land use and coastal infrastructure come from future offshore wind development, which does not change between alternatives. BOEM anticipates the cumulative impacts under the Proposed Action and Alternatives C, D1, D2, E, and F, when combined with the past, present, and reasonably foreseeable activities, to result in **negligible** to **minor beneficial** impacts at ports, **negligible** to **moderate** impacts for the onshore infrastructure, and **minor** impacts resulting from the views of offshore WTGs. Alternative B would have the same impacts except that it would result in **negligible** to **minor** impacts for the onshore infrastructure. The IPFs for accidental releases, port utilization, and structures (specifically onshore infrastructure) could result in cumulative impacts if land use and coastal infrastructure is stressed by future offshore wind project development before it has completely recovered from previous impacts. The IPF for views of offshore WTGs would result in cumulative impacts throughout the operational life of the offshore wind facilities.

In conclusion, the overall cumulative impacts on land use from any action alternative when combined with past present and reasonably foreseeable activities would be **minor** and **minor beneficial**. This impact rating is primarily driven by views of offshore structures, installation of onshore infrastructure and port utilization.

3.13. Navigation and Vessel Traffic

3.13.1. No Action Alternative Impacts

Table 3.13-1 contains a detailed summary of the baseline conditions and the impacts of ongoing and future offshore activities other than offshore wind on navigation and vessel traffic, based on the IPFs assessed. This information comes primarily from the Draft EIS, supplemented by information developed in responding to comments on the Draft EIS and additional information. The impact analysis is limited to impacts within the geographic analysis area for navigation and vessel traffic as described in Table A-1 and shown on Figure A.7-12 in Appendix A, and generally includes areas within 12.4 miles (20 kilometers) of the RI and MA Lease Areas, as well as ports used for construction or operation of the Proposed Action.

The coastal areas offshore Massachusetts, Rhode Island, and the rest of New England support high volumes of vessel traffic, including cargo, tanker, and other heavy vessel traffic to and from major ports in Boston and New York, as well as commercial and recreational fishing, ferries, and other recreational vessel activity. Commercial fishing vessels and recreational vessels comprise a large majority of vessel activity in the geographic analysis area for navigation and vessel traffic, although tug-and-barge, tanker, and other vessels are not uncommon. The heaviest vessel traffic in the vicinity of the WDA occurs in four primary areas: Narragansett Bay, Buzzards Bay, Nantucket Sound, and the area between Woods Hole and Vineyard Haven. The most prevalent vessel route pattern through the WDA is a roughly northwest/southeast orientation (Draft EIS Section 3.4.7.1). Generally, BOEM does not anticipate any substantial changes to navigation and vessel traffic patterns in the study area over the course of the next 30 years, except in response to offshore wind development, as discussed below.[13] Navigational safety considerations include many factors such as crew alertness, vessel seaworthiness, sea conditions, and accessibility to SAR assets. As discussed below, adding construction vessels and structures such as WTGs and ESPs to open waters (as well as increased activity in port areas) can increase crew fatigue and navigational complexity, increasing allision and collision risk. Further, the presence of structures could complicate SAR response for vessels that become imperiled by allision, collision, or other incidents.

A detailed analysis of impacts associated with future offshore wind development (other than the Proposed Action) is provided below in Section 3.13.1.1 and summarized in Table 3.13-1. Cumulative impacts of the Proposed Action and Action Alternatives are analyzed in Section 3.13.2.

Under the No Action Alternative, the proposed Project would not be built and hence would have no navigation or vessel traffic impact. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. If the Vineyard Wind 1 Project were not approved, then the impacts from the proposed Project would not occur as proposed. However, the state demand that the Vineyard Wind 1 Project would have filled, if approved, could likely be met by other projects in the geographic analysis area for navigation and vessel traffic. Therefore, the impacts on navigation and vessel traffic would be similar, but the exact impact 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 and considers the assumptions included in

[13] The Draft EIS cited 2016 and 2017 vessel traffic data. BOEM does not anticipate that 2018 data, now available, would differ from the data already cited; therefore, the baseline data included in the Draft EIS remain the basis for the analysis in this SEIS.

Section 1.2 and in Appendix A. A detailed analysis of impacts associated with future offshore wind development is provided in Section 3.13.1.1 and summarized in Table 3.13-1.

3.13.1.1. Future Offshore Wind Activities (without Proposed Action)

BOEM expects these future offshore wind activities to affect navigation and vessel traffic through the following primary IPFs.

Anchoring: Future offshore wind developers are expected to coordinate with the maritime community and USCG to avoid laying export cables through any traditional or designated lightering/anchorage areas, meaning that any risk for deep draft vessels would come from anchoring in an emergency scenario, specifically in or near the Buzzards Bay and Narragansett Bay traffic separation scheme (TSS) lanes. Generally, larger vessels accidently dropping anchor on top of an export cable (buried or mattress protected) to prevent drifting in the event of vessel power failure would result in damage to the export cable, risks associated with an anchor contacting an electrified cable and impacts to the vessel operator's liability and insurance. Impacts on navigation and vessel traffic would be temporary, localized, and navigation and vessel traffic would be expected to fully recover following the disturbance. In total, BOEM estimates approximately 126 acres (0.5 km^2) of seabed would be disturbed by anchoring associated with offshore wind activities. Considering the small size of this area compared to the remaining area of open ocean, as well as the likelihood that any anchoring risk would occur in an emergency scenario, it is unlikely that vessel anchors would impact navigation.

Port utilization: Future offshore wind development would support planned expansions and modifications at ports in the geographic analysis area for navigation and vessel traffic, including the ports of New Bedford, Providence, and Davisville (Quonset Point). 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 activity could lead to increased risk of allision, collision, and vessel delay. This increase in vessel traffic and navigation risk would be at its peak in 2022 to 2023, when more than 300 WTGs and ESPs associated with multiple offshore wind projects would be simultaneously under construction, would decrease as projects become operational, and would increase again during decommissioning. Based on the vessel traffic generated by the Proposed Action, BOEM assumes that construction of each future offshore wind project would generate an average of 25 and a maximum of 46 vessels operating in the geographic analysis area for navigation and vessel traffic at any given time, and that each future offshore wind project would generate a daily average of 18 vessel trips during peak construction (Epsilon 2018a). Up to four offshore wind projects would be under construction at the same time in 2022 and 2023. During this peak period, the No Action Alternative would therefore result in 100 to 184 vessels operating simultaneously, generating up to 72 vessel trips per day to and from ports in the region (assuming overlap of the peak construction periods of all four simultaneous projects). Fewer vessels would be present, and fewer trips would occur during other parts of the overall construction period (2021 to 2030) for offshore wind projects in the RI and MA Lease Areas. The increase in port utilization due to this vessel activity would vary across ports, and would depend on the specific port or ports supporting each future 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. During peak activity, impacts on port utilization would be short-term, continuous, and localized to the ports and their maritime approaches.

Presence of structures: Using the assumptions in Appendix A, the expanded cumulative scenario would include approximately 955 WTGs and 20 ESPs in the geographic analysis area for navigation and vessel traffic, operating for approximately 30 years. Structures in this area would pose navigational hazards to vessels transiting within and around areas leased for offshore wind projects. Offshore wind projects would increase navigational complexity and ocean space use conflicts, including the installation of WTG and ESP structures in areas where no such structures currently exist, potential compression of vessel traffic both outside of and within wind development areas, and potential difficulty seeing other vessels due to a cluttered view field. As stated in Table A-4 in Appendix A, BOEM assumes that all offshore wind developments would use 1 x 1 nautical mile spacing in fixed east-to-west rows and north-to-south columns. This arrangement would reduce, but not eliminate, navigational complexity and space use conflicts during the operation phases of the projects. Navigational complexity in the area would increase during construction as WTGs and ESPs are installed, would remain constant during simultaneous operations, and would decrease as projects are decommissioned and structures are removed.

Potential impacts of these conflicts include increased risk of allisions with stationary structures or vessels and collisions with other vessels, along with risk of damage to vessels or injury to crews; increased demand for USCG SAR operations due to the increase in allisions (and difficulty completing those operations due to the presence of WTGs); and increased risk of oil or chemical spills from collisions and allisions (Section A.8.2).

The fish aggregation and reef effects of offshore wind structures would also provide new opportunities for recreational fishing, although few recreational vessels presently travel as far from shore as the proposed offshore wind structures. The additional recreational vessel activity focused on aggregation and reef effects would incrementally increase vessel congestion and the risk of allision, collision, and spills near WTGs. As stated in Section 3.5.1, some marine mammals may choose to avoid WTGs and ESPs. This could potentially increase the risk of cetacean interaction with vessels, marginally increasing the likelihood of a vessel strike outside of WDAs.

Overall, the impacts of this IPF on navigation and vessel traffic would be long-term, regional (throughout the entire geographic analysis area for navigation and vessel traffic), and constant.

New cable emplacement/maintenance: Based on the assumptions in Table A-4 in Appendix A, the 975 foundations (955 WTGs and 20 ESPs) would require about 1,480 statute miles (2,381 kilometers) of inter-array and interlink cables. The length of OECC cable routes cannot be determined; however, one OECC is assumed to extend between each offshore wind project and the approximate nearest shoreline. 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 cross cable routes during installation and maintenance activities. The impacts of this IPF on vessel traffic and navigation under the No Action Alternative would be short-term, localized, and would be most disruptive during peak construction activity of the offshore wind projects starting in 2022.

Traffic: Based on the vessel traffic generated by the proposed Project, it is assumed that construction of each individual offshore wind project (estimated to last 3 years per project) would generate an average of 25 and a maximum of 46 vessels operating in the geographic analysis area for navigation and vessel traffic at any given time. Other vessel traffic in the region (e.g., from commercial fishing, for-hire and individual recreational use, shipping activities, military uses, etc.) would overlap with offshore wind-related vessel activity in the open ocean and near ports supporting the offshore wind projects. As shown in Table A-6 in Appendix A, this increase in vessel traffic and navigation risk would be at its peak in 2022 to 2023, when more than 300 WTGs and ESPs associated with at least four offshore wind projects (other than the Proposed Action) would be under simultaneous construction—i.e., a total of approximately 100 to 184 vessels in the geographic analysis area for navigation and vessel traffic at any given time during peak construction.[14] This increased offshore wind-related vessel traffic during construction would have 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 operational offshore wind facilities would consist of scheduled inspection and maintenance activities (an example schedule is provided in Vineyard Wind COP Volume I, Figure 4.3-1; Epsilon 2018a), with corrective maintenance as needed. During operation, project-related vessel traffic would have long-term, intermittent, localized impact on overall vessel traffic and navigation. Vessel activity would increase again during decommissioning at the end of the assumed 30-year operating period of each project, with magnitudes and impacts similar to those described for construction.

3.13.1.2. Conclusions

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impacts on navigation and vessel traffic. BOEM expects ongoing activities, future non-offshore wind activities, and future 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.

Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in overall **moderate** adverse impacts. Future 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, as well as an increased likelihood of collisions and allisions, with resultant increased risk of accidental releases. In addition, the No Action Alternative would lead to the construction of approximately 957 WTGs and 20 ESPs in in areas where no such structures currently exist, also increasing the risk for collisions, allisions, and resultant accidental releases and threats to human health and safety. Sections 3.7.1, 3.10.1, and 3.11.1 discuss the cumulative impacts on resource areas other than offshore wind that would generate vessel traffic.

3.13.2. Proposed Action and Action Alternatives

3.13.2.1. Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on navigation and vessel traffic were described in Draft EIS Section 3.4.7.2, and additional information is included in Table 3.13-1. Changes to the design capacity of the WTG to be used would not alter the maximum potential impact on navigation and vessel traffic for the Proposed Action and all other action alternatives, because the most impactful scenario involves the maximum number of WTGs (100) and ESPs (2). Increasing the size of the proposed substation by 2.2 acres (less than 0.1 km^2), as described in Chapter 2, would not change the analysis of impacts on navigation and vessel traffic for the Proposed Action and all other action alternatives, because the expanded substation area would be onshore within a designated industrial area (Section 3.12.2).

The cumulative impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are listed by IPF in Table 3.13-1. The most impactful IPFs would be the presence of structures, vessel traffic, and port utilization. The natures of the primary IPFs affecting navigation and vessel traffic and the natures of potential impacts on navigation and vessel traffic are described in Sections 3.13.1.1 and 3.13.1.2.

Cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities would be of similar types described in Section 3.13.1, but may differ in intensity and extent. It is assumed that the energy demand that the Vineyard Wind 1 Project would fill (if approved) would likely be met by other projects in remaining areas of the Massachusetts, Rhode Island, and/or New York leases (if not approved). Although the impacts from a substitute project may differ in location and time, depending on where and when offshore wind facilities are developed to meet the remaining demand, the nature of impacts and the total number of WTGs would be similar either with or without the Proposed Action, as described in Section 3.13.1. In other words, future offshore wind facilities capable of generating 9,404 MW would be built in the RI and MA Lease Areas, although, in the absence of the Proposed Action, none would be built before 2021. The Proposed Action would add 800 MW to the total 9,404 MW generating capacity from other offshore wind facilities in the geographic analysis area for navigation and vessel traffic.

Port utilization: The Proposed Action would generate vessel traffic at the Port of New Bedford during construction (as well as potentially at Providence and Davisville) and Vineyard Haven Harbor during operations. As stated in Draft EIS Section 3.4.7.3, construction of the Proposed Action would generate an average of 25 and a maximum of 46 vessels operating in the WDA or over the OECC route at any given time. Vessel traffic generated by the Proposed Action would constitute less than 10 percent of typical

[14] As specified in the SEIS, Section 1.2, BOEM's analysis of the reasonably foreseeable build-out scenario assumes the potential challenges of vessel availability and supply chain will be overcome and projects will advance.

daily vessel transits into and out of the Port of New Bedford. As discussed in Draft EIS Section 3.4.7.3, selection of the New Hampshire Avenue cable landfall site and the OECC route through Lewis Bay could cause delays and could cause vessel operators to change routes or use an alternative port. The Proposed Action's impacts on vessel traffic due to port utilization would be short--term, continuous, and **moderate**. 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, although these demands would likely be spread across time, and amongst a greater variety of ports within and outside of the geographic analysis area for navigation and vessel traffic. As stated in Section 3.13.1.1, up to four offshore wind projects (including the Proposed Action) would be under construction at the same time in 2022 and 2023. During this peak period, the No Action Alternative and Proposed Action would result in 100 to 184 vessels operating simultaneously, generating up to 72 vessel trips per day to and from ports in the region (assuming overlap of the peak construction periods of all four simultaneous projects). The increase in port utilization due to this vessel activity would vary across ports, and would depend on the specific port or ports supporting each future offshore wind project (including, but not limited to the ports used by the Proposed Action, as listed in DEIS Section 3.4.7.3). It is unlikely that all projects would use the same ports; therefore, the total increase in vessel traffic would likely be distributed across multiple ports in the region. Accordingly, the cumulative impacts of the Proposed Action when combined with the No Action Alternative, would have short-term, continuous, and **moderate** impacts on navigation and vessel traffic, due to port utilization.

Presence of structures: The Proposed Action would include up to 100 WTGs and 2 ESPs, operating for approximately 30 years, within the WDA where no such structures currently exist. The Proposed Action's structures would increase the risk of allision, as well as collision with other vessels navigating through WTGs; would interfere with marine radars (although other navigation tools are available to ship captains); and could cause long-distance sailing races to alter course. The increased risk of allisions and collisions would, in turn, increase the risk of spills (Section A.8.2). Vessel owners would likely need to add navigation and communication equipment to safely navigate through the offshore wind project. Nonetheless, the Proposed Action's structures and layout (i.e., lacking 1 x 1 nautical mile spacing and not being aligned in east-west rows and north-south columns) could make it more difficult for SAR aircraft to perform operations in the lease area, leading to less effective search patterns or earlier abandonment of searches. This could lead to increased loss of life due to maritime incidents. Nearly all vessels that travel through the RI and MA Lease Areas where no structures currently exist would need to navigate with greater caution to avoid WTGs and ESPs. According to AIS data, fishing vessels typical of the area would be able to complete 180-degree turns within a row of WTGs or from one row to another, but would still need to navigate with more caution than is currently necessary, especially during inclement weather. Increased navigational awareness while navigating through WTGs could lead to increased crew fatigue, which could also increase the risk of allision or collision and resultant injury or loss of life. The Proposed Action's structures would include USCG- and FAA-required markings, lighting, and other aids to navigation, and Vineyard Wind would maintain a Marine Coordinator and Mariner Communication Plan for the life of the proposed Project. Overall, the structures would have localized (to the WDA), long-term, continuous, **moderate** impacts on navigation and vessel traffic.

As described in Sections 3.13.1.1 and 3.13.1.2, structures from other offshore wind activities would generate comparable types of impacts on the Proposed Action, across the entire RI and MA Lease Areas, with the extent of coverage increasing as additional offshore wind projects are constructed. The layout of the Proposed Action's WTGs would differ from the predominant orientation of other offshore wind projects in both spacing (less than 1 x 1 nautical miles) and orientation (rows of WTGs not oriented east-west and north-south). This disparity in orientation would further hamper SAR activities. As a result, the cumulative impacts from the presence of structures for the Proposed Action when combined with past, present, and reasonably foreseeable activities would have regional, long-term, continuous, **major** impacts on navigation and vessel traffic.

New cable emplacement/maintenance: The Proposed Action's direct and indirect contribution to cable emplacement and maintenance would consist of the Vineyard Wind 1 Project's OECC and inter-array and interlink cables. The OECC would traverse 37 to 43 miles (depending on the route and cable-landing site selected), while the inter-array and interlink cables would encompass about 176 linear miles (Draft EIS Chapter 2). The presence of slow-moving (or stationary) installation or maintenance vessels would increase the risk of collisions and spills. Vessels not involved in cable emplacement or maintenance would need to take additional care when crossing cross cable routes, or avoid installation or maintenance areas entirely during installation and maintenance activities. As stated in Draft EIS Section 3.4.7.3, the presence of installation or maintenance vessels would have localized, short-term, intermittent, **minor** impacts on navigation and vessel traffic in general, and **moderate** impacts in Lewis Bay if the New Hampshire Avenue cable-landing site is selected.

Cable installation and maintenance for other offshore wind activities would generate comparable types of impacts on the Proposed Action for each OECC route and inter-array and interlink system, as described in Sections 3.13.1.1 and 3.13.1.2. As shown in Appendix A, Table A-4, OECC and inter-array/interlink cables for up to five other offshore wind projects could be under construction simultaneously. Simultaneous construction of inter-array and interlink 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 inter-array/interlink system at any given time. Based on the location of other offshore wind projects and the nearest shorelines, it is unlikely that OECC routes for these projects would overlap geographically, even if they are simultaneously under construction. Substantial areas of open ocean would thus separate simultaneous OECC and inter-array/interlink installation activities for other offshore wind projects. As a result, the cumulative impacts of cable installation for the Proposed Action when combined with past, present, and reasonably foreseeable activities would have localized, short-term, intermittent, **minor** impact on navigation and vessel traffic, except for **moderate** impacts in Lewis Bay if the New Hampshire Avenue cable-landing site is selected. The cumulative impacts of cable maintenance during operation of the Proposed Action and No Action Alternative would be localized, long-term, intermittent, and **negligible**.

Traffic: As stated in Draft EIS Section 3.4.7.3, construction of the Proposed Action would generate an average of 25 and a maximum of 46 vessels operating in the WDA or over the OECC route at any given time. The presence of these vessels would increase the risk of allisions, collisions and spills (Section A.8.2); however, vessels not associated with the Proposed Action would be able to avoid Proposed Action vessels though routine adjustments in navigation. An increase in avoidance measures could lead to over-avoiding and alliding with fixed structures or non-moving vessels. During construction, Proposed Action vessel traffic in ports (including the MCT and other ports identified above) would result in vessel traffic congestion, limited maneuver space in navigation channels, and delay in ports, and could also increase the risk of collision, allision, and resultant spills in or near ports. Vessel traffic generated by Proposed Action construction would constitute less than 10 percent of typical daily vessel transits into and out of the Port of New Bedford (Vineyard Wind COP Appendix III-I; Epsilon 2018a), but could nonetheless restrict maneuvering room and cause delays accessing the port. Selection of the New Hampshire Avenue cable landfall site and the OECC route through Lewis Bay could cause delays and could cause vessel operators to change routes or use an alternative port. Operation of the Proposed Action would generate one to three vessel trips per day from the MCT or Vineyard Haven to the WDA.

Accordingly, as stated in Draft EIS Section 3.4.7.3, the Proposed Action's vessel traffic would have localized, short-term, continuous, **minor** impacts on overall navigation and vessel traffic in open waters and **moderate** impacts near ports (including, but not limited to the Port of New Bedford and Lewis Bay, if the New Hampshire Avenue cable-landing site is selected). Operation of the Proposed Action would have localized, long-term, intermittent, **minor** impacts on overall navigation and vessel traffic near ports and in open waters.

As described in Sections 3.13.1.1 and 3.13.1.2, each other offshore wind project would generate comparable amounts of vessel traffic as Proposed Action, and as many as four offshore wind projects could be under construction simultaneously in 2022 to 2023. Because the ports to be used by other offshore wind projects have not been determined, the overlap of vessel activity at any single port cannot be predicted. Traffic from these projects would likely be spread amongst multiple ports within and outside of the geographic analysis area for navigation and vessel traffic, thus potentially moderating the effect of offshore wind-related vessel traffic at any single location. As a result, the cumulative impacts of vessel traffic on overall navigation and vessel traffic at any single port in the geographic analysis area for navigation and vessel traffic would be localized, short-term, intermittent, and **minor** in open waters and **moderate** near ports. The cumulative impacts of offshore wind-related vessel traffic on overall navigation and vessel traffic during operation of the Proposed Action and No Action Alternative would be localized, long-term, intermittent, and **minor**.

Cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from **negligible** to **major**. The main IPF is the presence of structures, which increase the risk of collision/allusion and navigational complexity. Considering all the IPFs together, BOEM anticipates the overall cumulative impacts on navigation and vessel traffic would be **major**, due primarily to the increased loss of life due to maritime incidents, which would produce significant local and possibly regional disruptions for ocean users in the RI and MA Lease Areas.

3.13.2.2. Cumulative Impacts of Alternatives B, C, D1 and E

The direct and indirect impacts of Alternatives B, C, D1, and E on navigation and vessel traffic are described in Draft EIS Sections 3.4.7.4 through 3.4.7.7. These impacts are summarized below.

- The difference between Alternative B and the Proposed Action is the selection of Covell's Beach as the cable landfall site, and the avoidance of impacts on navigation and vessel traffic in Lewis Bay, a densely traveled port (DEIS Section 3.4.7.3). The other impacts of Alternative B would be the same as those of the Proposed Action.
- The difference between Alternative C and the Proposed Action is the relocation of the six northernmost WTG locations to the southern portion of the WDA. The WTG locations in Alternative C would incrementally decrease impacts on vessel traffic compared to the Proposed Action by providing additional space closer to offshore areas more frequently used by recreational vessels. This change notwithstanding, the overall impacts of Alternative C on navigation and vessel traffic would be the same as those of the Proposed Action.
- Alternative D1 would establish uniform 1 x 1 nautical mile spacing between WTGs (compared to 0.75 nautical mile with the Proposed Action), but would not alter the orientation of the lanes between WTGs. The total acreage of the WDA would increase by about 22 percent (an increase of 16,603 acres or 67.2 km^2). Compared to the Proposed Action, the increased spacing of the WTGs could incrementally decrease impacts on navigation and vessel traffic safety, compared to the Proposed Action, while the potentially larger footprint of the WDA would increase the geographical scope of impacts. Neither factor would change the overall impact magnitudes described for the Proposed Action.
- Alternative E would involve construction of 57 to 84 WTGs, each with generation capacity ranging from approximately 9.5 to 14 MW. Although Alternative E would result in fewer structures than the Proposed Action, construction, installation, and decommissioning of Alternative E would have similar impacts on navigation and vessel traffic as the Proposed Action. During operations and maintenance, vessel operators in the WDA would still need to navigate around WTGs and ESPs. The size of the WDA could be smaller than under the Proposed Action, depending on ultimate siting locations. The increased spacing of the WTGs and/or potentially smaller footprint of the WDA could incrementally decrease impacts on navigation and vessel traffic safety, compared to the Proposed Action, but would not change the overall impact magnitudes described for the Proposed Action.

Accordingly, the direct and indirect impacts resulting from individual IPFs associated with Alternatives B, C, D1, and E on navigation and vessel traffic would be the same as those of the Proposed Action—**negligible** to **moderate**.

The cumulative impacts resulting from individual IPFs associated with Alternatives B, C, D1, and E on navigation and vessel traffic, when combined with past, present, and reasonably foreseeable projects, would be similar as those of the Proposed Action—**negligible** to **major**. Because the majority of the cumulative impacts of any alternative come from other offshore wind projects, and the direct and indirect impacts of this alternative would be very similar to those of the Proposed Action.

The overall cumulative impacts of each alternative when combined with past, present, and reasonably foreseeable activities on navigation and vessel traffic within the geographic analysis area would be of the same level as under the Proposed Action—**major**, due primarily to the increased loss of life due to maritime incidents, which would produce significant local and possibly regional disruptions for ocean users in the RI and MA Lease Areas.

3.13.2.3. Cumulative Impacts of Alternative D2

The direct and indirect impacts of Alternative D2 on navigation and vessel traffic are described in Draft EIS Section 3.4.7.6. Alternative D2 would result in 1 x 1 nautical mile spacing between WTGs, with WTGs arranged in east--to--west rows and north-to-south columns, matching the orientation that BOEM assumes for all other future offshore wind projects. Alternative D2 would also result in a 22 percent larger WDA (an increase of 16,603 acres or 67.2 km^2). These changes would reduce navigational complexity for vessel traffic, leading to a decrease in impacts on navigation and vessel traffic safety, compared to the Proposed Action. The larger WDA in this alternative could incrementally increase impacts on navigation and vessel traffic safety. However, the regular and predictable layout would increase navigational safety by allowing vessel operators to set predictable courses, and by allowing the USCG to set predictable SAR patterns and successfully complete more SAR missions, thus avoiding fatalities that might otherwise occur with the Proposed Action or other WTG layouts. The USCG's Draft MARIPARS report evaluated vessel traffic through the lease areas and recommended all surface structures be aligned in a 1 x 1 nautical-mile grid, such that vessels anywhere in the RI and MA Lease Areas would pass one WTG on either side every 1 nautical mile when traveling north-south or east-west, and every 0.6 to 0.8 nautical mile when traveling northwest-southeast or northeast-southwest (USCG 2020). Evaluated holistically, these changes would provide a more predictable, consistent, and accessible layout for SAR activities, thus improving (compared to the Proposed Action and other alternatives) SAR response and success. Therefore, the direct and indirect impacts resulting from individual IPFs associated with Alternative D2 are expected to result in **negligible** to **moderate** impacts on navigation and vessel traffic.

The cumulative impacts resulting from individual IPFs associated with Alternative D2 on navigation and vessel traffic, when combined with past, present, and reasonably foreseeable activities, would be **negligible** to **moderate**. This is mainly due to the coordination of the Alternative D2 WTG layout with layouts of adjacent future offshore wind projects, as well as improved USCG SAR response, compared to the Proposed Action and other alternatives. The overall cumulative impacts of Alternative D2 when combined with past, present, and reasonably foreseeable activities on navigation and vessel traffic within the geographic analysis area would be lower than under the Proposed Action—**moderate**—due to improved SAR access and reduced loss of life. These impact ratings are driven by the construction, installation, and presence of offshore wind structures, and the increased risk of vessel allision and collision.

3.13.2.4. Direct, Indirect, and Cumulative Impacts of Alternative F

Alternative F analyzes a vessel transit lane through the WDA, in which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The WTGs that would have been located within the transit lane would be shifted to locations south within the lease area. Under this alternative, BOEM is analyzing a 2- and 4-nautical-mile northwest/southeast vessel transit lane through the WDA combined with any action alternative; however, this analysis focuses on the combination of Alternative F with either the Proposed Action or Alternative D2 layout. Although the 1-nautical mile rows and columns between WTGs under Alternative D2 could be considered transit lanes, the analysis of this alternative focuses on the 2- and 4-nautical-mile transit lanes described above. The Alternative D2 layout was selected because it is the only layout amongst the Proposed Action and action alternatives that includes both 1 x 1 nautical mile WTG spacing and east-west rows/north-south columns (matching the layout that BOEM assumes for other future offshore wind projects).

The number of WTGs installed under Alternative F would remain the same, regardless of layout. The northern transit lane within the WDA could result in the relocation of 16 to 34 WTG placements south of the WDA, an increased extent of inter-array cables, and a 12 to 61 percent increase in the size of the WDA, depending on whether the Proposed Action or Alternative D2 layout is used and whether the 2- or 4-nautical-mile transit lane is used (Section 2.2.2).

Regardless of layout or transit lane width, transit lanes may cause funneling of transiting traffic and may create choke and intersection points. If all transiting vessels prefer to move through the transit lanes, this will cause more dense rather than dispersed traffic. This funneled traffic would also result in space use conflict if any commercial fishing activity occurs in the transit lanes. Transit lanes may also require development of lease areas further south than anticipated, potentially resulting in standalone locations with only a few turbines. This would cause a further rerouting south of deep-draft and tug and towing vessels that would otherwise avoid the areas.

. As cooperating agencies, BOEM and the USCG will continue to consult over the course of the NEPA process for the proposed Project as it relates to navigational safety and other aspects. The USCG will make a final recommendation on transit routes after comments received during the Draft MARIPARS report comment period are assessed. The direct and indirect impacts of Alternative F on navigation and vessel traffic would vary based on the width of the transit lane and the underlying layout used, as discussed below.

The primary differences between the Proposed Action and the combination of Alternative F and the Proposed Action would be the establishment of an up to 4-nautical-mile-wide transit lane through the WDA resulting in the following change in impacts, compared to the Proposed Action alone:

- Reduced impacts related to structures and vessel collisions, due to the presence of a transit lane parallel to (or crossing perpendicularly) the approximate predominant orientation of WTGs.
- An increased affected area due to expansion of the overall area where WTGs would be installed, where no such structures currently exist.
- Transit lanes may also cause funneling of transiting traffic and may create choke and intersection points. If all transiting vessels prefer to move through the transit lanes, this will cause more dense rather than dispersed traffic. This funneled traffic would also result in increased space use conflict if any commercial fishing activity occurs in the transit lanes.

- Because mariners would not be required to use the transit lanes, and because active fishing would not be restricted within the transit lanes, simultaneous with transiting traffic, the implementation of transit lanes could increase the risk of allision or collision (and resultant spills).

None of the differences listed above, and neither transit lane width analyzed (2- or 4-nautical mile) would change the overall **moderate** direct impact on navigation and vessel traffic from the presence of structures, as described for the Proposed Action. The addition of a transit lane, regardless of width, would not change the IPFs for Alternative F in combination with the Proposed Action. As a result, the range of direct impacts of these IPFs would remain the same as or substantially similar to those of the Proposed Action, and would have direct, **negligible** to **moderate** impacts on navigation and vessel traffic.

The cumulative impacts of Alternative F with the Proposed Action layout would be very similar to the cumulative impacts under the Proposed Action, with individual IPFs leading to impacts ranging from **negligible** to **major** impacts on navigation and vessel traffic. The overall cumulative impacts of Alternative F with the Proposed Action layout, when combined with past, present, and reasonably foreseeable activities on navigation and vessel traffic would be of the same level as under the Proposed Action—**major**, due to reduced SAR success and the resultant increased loss of life.

The impacts from the combination of Alternative F with Alternatives B, C, D1, and E are expected to be similar to the combination with the Proposed Action. Alternative B would not change the layout of the Proposed Action's WTGs and would only utilize the Covell's Beach landfall. Alternative C would shift the six northernmost WTG positions to the southern portion of the WDA, but would not change the WTG layout in the portion of the WDA affected by northern transit lane under Alternative F. While Alternative D1 would result in wider spacing between WTGs in comparison to the Proposed Action, this increased spacing would not meaningfully change the IPFs described above for Alternative F in combination with the Proposed Action. Alternative E would result in fewer WTGs in the WDA (compared to the Proposed Action) and thus a smaller WDA, but would not affect WTG spacing.

As a result, while the direct impacts of IPFs associated with Alternative F, combined with Alternatives B, C, D1, and E could differ from those of Alternative F combined with the Proposed Action, these impacts would still have **negligible** to **moderate** direct and indirect impacts on navigation and vessel traffic, resulting in overall **major** cumulative impacts, due to increased loss of life from the presence of structures.

While the presence of the northern transit lane would facilitate travel for vessels seeking pass through the entire WDA, as well as cumulatively for vessels passing through the combined lease areas, the Draft MARIPARS report stated that WTGs with 1-nautical mile spacing and north-south/east-west orientation (i.e., the Alternative D2 layout) would facilitate traditional fishing methods (east-to-west travel) in the area, and would provide the USCG with adequate SAR access (north-to-south travel) (USCG 2020). Establishment of a northern transit lane through the Alternative D2 layout under Alternative F would result in the following impacts on navigational safety that differ from the Proposed Action or Alternative D2 alone:

- Although the presence of a northern transit lane would facilitate travel for vessels seeking to pass through the entire WDA, it is still likely that some commercial and recreational fishing and boating could occur within the RI and MA Lease Areas, including active fishing within the transit lane.
- The traditional fishing and transiting orientation and the orientation of rows between WTGs in the Alternative D2 layout (i.e., east-to-west) differs from the northwest-southeast orientation of the northern transit lane under Alternative F, and may cause use conflicts within the transit lanes (Sections 3.10.2 and 3.11.2).
- As described in Section 3.13.2.3, the Alternative D2 layout would allow vessel operators to set predictable courses, and would allow the USCG to set predictable SAR patterns and successfully complete more SAR missions. Furthermore, this layout would be consistent with the recommendations in the Draft MARIPARS report (USCG 2020).

Due to the safety advantages of the Alternative D2 layout, the overall magnitude of the direct impacts on navigation and vessel traffic under Alternative F with the combination of the Alternative D2 layout would be **negligible** to **moderate**. Impacts from other IPFs under Alternative F in combination with Alternative D2 would remain the same as or substantially similar to those of Alternative D2 because the addition of a transit lane, regardless of width, would not change the other IPFs. As a result, the direct and indirect impacts of Alternative F in combination with the Alternative D2 layout would have **negligible** to **moderate** impacts on navigation and vessel traffic.

The cumulative impacts resulting from individual IPFs associated with Alternative F in combination with the Alternative D2 layout would be **negligible** to **moderate**. This impact rating is primarily driven by the construction, installation, and presence of offshore wind structures, and the increased risk of vessel allision and collision. The overall cumulative impacts of Alternative F in combination with the D2 layout, when combined with past, present, and reasonably foreseeable activities on navigation and vessel traffic would be **moderate**, due to improved SAR operations and reduced loss of life (as compared to Alternative F combined with the Proposed Action layout or other action alternatives).

Different transit lane widths would not change the list of IPFs affecting navigation and vessel traffic, but would emphasize different aspects of the IPFs and associated sub-IPFs listed in Table 3.13-1. A 2-nautical-mile transit lane would result in greater traffic density within the transit lane than a 4-nautical-mile lane (i.e., by compressing the same traffic volumes into a narrower lane) and less maneuvering space, leading to a greater chance of collision or allision with structures or stationary vessels. Due to its smaller size, commercial and recreational fishing vessels could more easily avoid active fishing within the 2-nautical-mile transit lane, thus reducing potential space conflicts within the 2-nautical-mile transit lane. By comparison, fishing vessels would be more likely to conduct active fishing within the 4-nautical-mile lane due to the larger area it comprises. This would increase the likelihood of an allision or collision, thereby increasing navigational safety risks. The 4-nautical-mile transit lane would also take longer to cross, but the lower traffic density (compared to the 2-nautical-mile width) would better enable traffic navigating along the transit lane to avoid crossing traffic.

Overall, the 2- or 4-nautical-mile transit lanes analyzed would not meaningfully change the cumulative impact magnitudes described above for Alternative F combined with the layout for the Proposed Action or Alternatives B, C, D1, or E (**major** overall impacts on navigation and vessel traffic) or for Alternative F combined with the Alternative D2 layout (**moderate** overall).

BOEM has qualitatively evaluated the cumulative impacts of implementing all six RODA-recommended transit lanes, including the northern transit lane described for Alternative F, as well as five other transit lanes through the RI and MA Lease Areas. The cumulative impacts on navigation and vessel traffic from implementation of all six transit lanes would be an overall increase in impacts from allisions and collisions. As discussed above, the northwest-southeast transit lane orientation through the WDA would differ from the east-west orientation of the WTGs (as analyzed in the cumulative scenario for all reasonably foreseeable offshore wind projects) and the east-west orientation preferred by many commercial fishing interests. In addition, some commercial and recreational fishing and boating could occur within the transit lanes (Sections 3.10.2.3 and 3.11.2.3). The differing orientations of the transit lanes and WTG layout could increase navigational complexity and safety risks for vessels. To the extent that additional transit lanes are implemented in the future outside of the Vineyard Wind lease area as part of RODA's suggestion, the WTGs for other future offshore wind projects may need to be located further from shore, similar to the proposed Project under Alternative F. As a result, establishment of additional transit lanes could require vessels that would not operate within the Lease Areas (e.g. cargo and tanker vessels) make longer trips for all phases of future projects and longer timeframes time for cable installation. This could result in greater impacts on navigation and vessel traffic due to increased risk of vessel allision and collision (due to the increased distance traveled), and increased threats to human health and safety.

3.13.2.5. Comparison of Alternatives

The Proposed Action would affect navigation and vessel traffic through the following IPFs: (1) anchoring; (2) port utilization; (3) presence of structures resulting in impacts related to allisions, fish aggregation, habitat conversion, migration disturbances, navigation hazards, space use conflicts, and transmission cable infrastructure; (4) new cable emplacement and maintenance activities; and (5) vessel traffic. The IPFs associated with the Proposed Action would result in direct, localized to regional, short- to long-term, **negligible** to **moderate** impacts on navigation and vessel traffic due to anchoring, port utilization, the presence of structures, cable emplacement and maintenance, and vessel traffic.

The direct and indirect impacts associated with the Proposed Action on navigation and vessel traffic are not substantially different from those associated with Alternatives B, C, D1, and E. Alternative B would avoid the direct and cumulative impacts on economic activity near Lewis Bay, by avoiding impacts on navigation and vessel traffic in Lewis Bay, a densely traveled port. Alternatives C and D1 would alter the layout of the proposed Project, but would not substantially change any of the IPFs related to navigation and vessel traffic. Alternative E would reduce the number of WTGs compared to the number of WTGs used in the Proposed Action and all other alternatives, but would have similar impacts on navigation and vessel traffic as the Proposed Action. As a result, the direct and indirect impacts resulting from individual IPFs for Alternatives B, C, D1, and E would result in **negligible** to **moderate** impacts on navigation and vessel traffic. Overall, Alternatives B, C, D1, and E would have **moderate** direct and indirect impacts on navigation and vessel traffic, due to increased loss of life resulting from the presence of structures (WTGs and ESPs).

Alternative D2 would align the proposed Project's WTGs in a 1 x 1 nautical-mile, east/west grid, consistent with the MARIPARS recommendations. This would facilitate SAR activities and avoid some of the loss of life identified for other alternatives. As a result, individual IPFs associated with Alternative D2 would result in **negligible** to **moderate** impacts on navigation and vessel traffic. Overall, Alternative D2 would have **moderate** direct and indirect impacts on navigation and vessel traffic.

Alternative F would establish an up to 4-nautical-mile-wide transit lane, running northwest to southeast, through the WDA and adjacent lease areas. This would facilitate travel through the WDA, but would also result in relocation of 16 to 34 WTG placements south of the WDA, an increased extent of inter-array cables, and a 12 to 61 percent increase in the size of the WDA. Implementation of Alternative F with the Proposed Action WTG layout would not change the magnitude of direct impacts described for the Proposed Action: individual IPFs would result in **negligible** to **moderate** impacts, with overall **moderate** impacts on navigation and vessel traffic. Implementation of Alternative F with the Alternative D2 layout would not change the magnitude of impacts described for Alternative D2: individual IPFs would result in **negligible** to **moderate** impacts, with overall **moderate** impacts on navigation and vessel traffic.

Cumulative impacts under any action alternative would likely be very similar because the majority of the cumulative impacts of any alternative come from future offshore wind development, which does not change between alternatives, and because the differences in direct and indirect impacts between action alternatives would not result in different direct and indirect impact magnitudes. As a result, the cumulative impacts of any alternative resulting from individual IPFs, when combined with past, present, and reasonably foreseeable activities would have direct, localized to regional, short- to long-term, **negligible** to **major** impacts on navigation and vessel traffic due to anchoring, port utilization, the presence of structures, cable emplacement and maintenance, and vessel traffic (except for Alternative F with the Alternative D2 layout, which would have **negligible** to **moderate** impacts). The overall cumulative impacts of any alternative when combined with past, present, and reasonably foreseeable activities on navigation and vessel traffic would be **major**, (except for Alternative D2 or Alternative F with the Alternative D2 layout: **moderate**) which is primarily driven by the construction, installation, and presence of offshore wind structures, and the increased risk of vessel allision and collision and associated threat to human health.

3.14. OTHER USES

3.14.1. No Action Alternative Impacts

Table 3.14-1 contains a detailed summary of baseline conditions and the impacts of ongoing and future offshore activities other than offshore wind on other uses, based on the IPFs assessed. This information comes primarily from the Draft EIS, supplemented by information developed in responding to comments on the Draft EIS and additional information. The impact analysis is limited within the geographic analysis area for each resource as described in Table A-1 and shown on Figure A.7-13 in Appendix A for military and national security uses, aviation and air traffic, cables and pipelines, and radar systems, and on Figure A.7-4 for scientific research and surveys. This includes the entire RI and MA Lease Areas, all of Cape Cod and southeastern Massachusetts, most of Rhode Island, Montauk, New York, and intervening areas of open ocean.

Baseline conditions for resources evaluated as "other uses" are summarized as follows:

- Military and National Security Uses: The United States Navy (Navy), the USCG, and other military and national security entities have numerous facilities in the region (Figure 3.4.8-1 in the Draft EIS). Onshore and offshore military and national security use areas may have designated surface and subsurface boundaries and special use airspace. Military activities are anticipated to continue into the future, and may include routine activities, as well as non-routine activities such as SAR operations. Military air traffic uses the area, and other government (or government-hired private) aircraft may occasionally fly over the WDA for data collection and SAR operations.
- Aviation and Air Traffic: There are numerous public and private-use airports in the region. The closest public airports to the WDA are Nantucket Memorial Airport on Nantucket and Katama Airpark and Martha's Vineyard Airport, both located on Martha's Vineyard. Private airports or airstrips near the proposed Project WDA are located on Tuckernuck Island and Martha's Vineyard (Trade Wind Airport). Other public and private airports and heliports are located on the mainland.
- Cables and Pipelines: The coastal region of Massachusetts and Rhode Island is served by an onshore electrical grid and a network of onshore pipelines. Islands in the region, including Block Island, Martha's Vineyard, and Nantucket, are served by submarine electrical transmission cables. Several transatlantic cables make landfall near Charlestown, Massachusetts. No offshore pipelines are located within or in the region immediately surrounding the proposed Project WDA or in the geographic analysis area.
- Radar Systems: Commercial air traffic control radar systems, national defense radar systems, and weather radar systems currently operate in the proposed Project region to serve national defense, weather, and air traffic control purposes.
- Scientific Research and Surveys: BOEM assumes that research in this area would include oceanographic, biological, geophysical, and archaeological surveys focused on the OCS and nearshore environments, and/or resources that may be impacted by offshore wind development. Federal agencies, state agencies, educational institutions, and environmental non-governmental organizations participate in ongoing research offshore in the RI and MA Lease Areas and surrounding waters. Aerial and ship-based research includes oceanographic, biological, geophysical, and archaeological surveys, and data collected support fisheries assessments and management actions, protected species assessments and management actions, ecosystem-based fisheries management, and regional and national climate assessments, as well as a number of regional, national, and international science activities. NMFS, the Northeast Fishery Science Center, and NOAA operate or support surveys related to ecological monitoring and fisheries stock assessments in the RI and MA Lease Areas and surrounding region. Other activities anticipated to continue or occur within the geographic analysis area include offshore wind site assessment activities, construction of reasonably foreseeable offshore wind facilities and associated cable systems, and vessel activity related to offshore wind development. Additional scientific surveys to ascertain impacts of offshore wind development are also likely to occur.

Draft EIS Section 3.4.8 also analyzed the potential impacts of the Proposed Action on marine mineral extraction and other offshore energy projects. BOEM is not analyzing the impacts of future offshore wind energy projects on these resources, for the following reasons:

- Marine Minerals Extraction: the Proposed Action would have no impacts on marine minerals extraction, and therefore would not contribute to cumulative impacts on marine minerals extraction. In addition, BOEM assumes that export cables associated with future offshore wind projects would avoid identified borrow areas identified through consultation with the BOEM Marine Minerals Program and USACE prior to approval of OECC routes, avoiding impacts on known borrow areas.
- Offshore Energy: Draft EIS Section 3.4.8 analyzes potential impacts of the Proposed Action on other offshore energy projects. The geographic analysis area includes the seven active offshore RI and MA Lease Areas that are not yet developed. No other reasonably foreseeable energy projects were identified in the geographic study area. While BOEM is not analyzing the cumulative impacts of future offshore wind energy on offshore energy, it is analyzing, in Section 3.14.2.4, the impact Alternative F could have on the area available for offshore development in leases OCS-A 0520, OCS-A 0521, and OCS-A 0500.

Under the No Action Alternative, the proposed Project would not be built and hence would have no other uses impact. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. If the Vineyard Wind 1 Project is not approved, then impacts from the proposed Project would not occur as proposed. However, the state demand that the Vineyard Wind 1 Project would have filled, if approved, could likely be met by other projects in the geographic analysis area for other uses. Therefore, the impacts on other uses would be similar, but the exact impact 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 and considers the assumptions included in SEIS Section 1.2 and Appendix A. A detailed analysis of impacts associated with future offshore wind development is provided in Section 3.14.1.1 and summarized in Table 3.14-1. Cumulative impacts of the Proposed Action and action alternatives are analyzed in Section 3.14.2.

3.14.1.1. Future Offshore Wind Activities (without Proposed Action)

BOEM expects these future offshore wind development activities to affect other uses through the following IPFs.

Military and National Security Uses

The wind energy areas geographic boundaries were developed through coordination with stakeholders to address concerns of overlapping military and security uses. BOEM continues to coordinate with stakeholders to minimize these concerns as needed.

Presence of structures: Existing stationary facilities that present allision risks are limited in the open waters of the geographic analysis area and include the five offshore wind turbines associated with Block Island Wind Farm and meteorological buoys operated for offshore wind farm site assessment. Dock facilities and other structures are concentrated along the coastline. Installation of up to 775 WTGs and 20 ESPs, plus the presence of lift vessels during construction within the lease areas, would increase the risk of allision for military and national security vessels, including USCG SAR vessels. In general, deep-draft military vessels are not anticipated to transit outside of navigation channels unless necessary for SAR operations or other non-typical activities. Therefore, vessels more likely to allide with WTGs or ESPs would be smaller-draft vessels moving within and near wind installation. Deep draft military and national security vessels near traffic separations schemes or port entrances could potentially lose power and allide with a nearby WTG. Risks would increase over time as additional wind energy facilities are built within the RI and MA Lease Areas starting in 2021 and continuing through reasonably foreseeable buildout in 2030 (Table A-4 in Appendix A). Wind energy facility structures would be lighted according to USCG and BOEM requirements at sea level to decrease allision risk. Allision risk would be further mitigated by the collaborative regional layout proposed by the five Rhode Island and Massachusetts offshore wind leaseholders, which arranges WTGs 1 x 1 nautical mile apart in fixed east-to-west rows and north-to-south columns across all lease areas offshore Massachusetts and Rhode Island. This arrangement is intended to facilitate safe navigation through the RI and MA Lease Areas (Brostrom et al. 2019). As described in Chapter 2, the USCG's ongoing MARIPARS is evaluating how transit corridors may affect allision risks. The draft study was published on January 29, 2020, and the USCG will make a final recommendation on transit routes after assessing the comments received during the Draft MARIPARS report comment period (USCG 2020).

The installation of up to 795 foundations within the geographic analysis area could create an artificial reef effect, attracting species of interest to 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. The USCG does not retain the authority to establish safety zones outside the territorial sea. Increased risk of conflict or collision risks for military and national security vessels is anticipated to be *de minimis*, because military vessels are not anticipated to transit outside of navigation channels unless necessary for SAR operations or other non-typical activities. Risk would gradually increase between 2021 and 2030 as offshore wind structures are installed across the RI and MA Lease Areas, and recreational fishing vessels begin to access the development area, and would decrease incrementally as projects are decommissioned and structures removed.

The addition of up to 795 foundations within the geographic analysis area between 2021 and 2030 would incrementally change navigational patterns and increase navigational complexity for vessels and aircraft operating in the region around wind energy projects. During construction periods between 2021 and 2030, use of stationary lift vessels in the lease areas and cranes at port locations would further increase navigational complexity in areas immediately around these tall structures. Increased navigational complexity would increase the risk of allisions for military and national security vessels as discussed above, and for military and national security aircraft. Similar to Vineyard Wind 1 Project, it is assumed that other offshore wind operators would implement a strict operational protocol with the USCG that requires the WTGs to stop rotating within a specified time to mitigate impacts to search and rescue aircraft operating in the leased areas. Prior to construction, applicants must file Form 7460-1 (Notice of Proposed Construction) with the FAA for each individual structure exceeding 200 feet (61 meters) tall within U.S. territorial waters, which triggers a review to identify and resolve potential aviation conflicts. The Department of Defense and the Department of Homeland Security (which includes the USGC) would be invited to review and comment on the filing (per Section 5-2-2(a) of FAA Order JO 7400.2M, Procedures for Handling Airspace Matters) (FAA 2020a), and BOEM assumes that this process would be utilized, in addition to any pre-permitting coordination performed by the project applicants, to identify and resolve potential conflicts with military air traffic. Implementation of navigational lighting and marking required by the FAA and BOEM would further reduce the risk of aircraft collisions. Wind energy structures (including WTGs and ESPs) would be visible on military and national security vessel and aircraft radar. It is assumed that all project operators would coordinate with relevant agencies during the COP development process to identify and minimize conflicts with military and national security operations. Navigational hazards would gradually be eliminated when structures are removed during decommissioning.

Access to active construction areas would be temporarily restricted within the RI and MA Lease Areas between 2021 and 2030. Presence of the proposed 795 foundations during the projects' operational timeframes would change long-term navigation patterns in and around the RI and MA Lease Areas. As multiple projects are built, changing navigation patterns could concentrate vessels around the edges of the cumulative WDA, potentially causing space use conflicts and increasing the risk of collisions between military/national security and civilian vessels. Warning area W-105A overlies the majority of the OCS-A 0500 and all of OCS-A 0520, OCS-A 0521, and OCS-A 0522. Because the authorized altitude associated with this segment of airspace begins at the sea surface, wind development in the lease areas developed during the No Action Alternative could have an increasing impact on military and national operations conducted within W-105A as construction occurs in these areas between 2021 and 2030, and a consistent impact during project operations. W-105A measures approximately 23,000 square miles (59,570 km^2) (FAA 2020b), with approximately 4 percent (approximately 1,000 square miles [(2,590 km^2]) located within the RI and MA Lease Areas. Space use conflicts would decrease during decommissioning as structures are removed.

Based on the assumptions in Appendix A, the Vineyard Wind 2, Mayflower Wind, South Fork Wind, a development by Equinor Wind, and the Bay State Wind offshore cables would be constructed within the geographic analysis area, as could cables associated with other future offshore wind farms. Of these, only Vineyard Wind 2, South Fork, and Mayflower Wind have announced plans for cable routes in the geographic analysis area; Vineyard Wind 2 would lay cable within the same OECC as the proposed Project, South Fork plans to make landfall in the New York area, and Mayflower Wind would lay cable somewhere between Martha's Vineyard and Muskeget Island, through Nantucket Sound, making landfall somewhere on Cape Cod. Precise cable corridors are not known for any specific project, but construction timeframes would likely be staggered between 2021 and 2030. Military and national security vessels may need to navigate around temporarily active construction sites above these cable routes. While projects are operational, transmission cables would be passive structures located on the seafloor, and would only potentially impact military and national security operations during very infrequent cable maintenance events.

Traffic: Vessel traffic associated with construction and decommissioning of future offshore wind facilities could cause military and national security vessels to change routes and experience congestion and delays in port and within vessel transit routes. Wind energy facility operators use vessels for construction, maintenance, and decommissioning activities, with the highest vessel traffic during construction (approximately 2021 through 2030) and decommissioning. Construction periods would likely be staggered, but some overlap is possible. Operational traffic would occur at lower, consistent levels over the 30-year operational timeframes for each project. Current levels of vessel traffic are discussed in Section 3.13. Vessel traffic from each future offshore wind project is anticipated to be similar to the proposed Project, and overall future offshore wind vessel activity would be most pronounced during construction and decommissioning time periods, when as many as five offshore wind projects could be under construction simultaneously. Similar to the proposed Project, operational traffic associated with each other offshore wind project would be anticipated to be similar to existing civilian vessel traffic in the region. Risks of collisions between military vessels and offshore wind vessels would be highest during construction and decommissioning.

Aviation and Air Traffic

Presence of structures: Construction of future offshore wind facilities could add up to 775 WTGs with maximum blade tip heights of up to 853 feet (260 meters) AMSL to the RI and MA Lease Areas between 2021 and 2030, and stationary construction cranes would be utilized in ports during construction. Addition of these structures would incrementally increase navigational complexity and change aircraft navigation patterns in the region around the leased areas offshore Massachusetts and Rhode Island and locally around ports. These changes could compress lower-altitude aviation activity into more limited airspace above the RI and MA Lease Areas, leading to airspace conflicts or congestion, and increasing collision risks for low-flying aircraft. However, open airspace around the RI and MA Lease Areas would still be available over the open ocean. Addition of WTGs throughout the RI and MA Lease Areas would alter navigation patterns associated with nearby airports, including but not limited to Nantucket Memorial Airport. Navigational hazards and collision risks would be gradually eliminated during decommissioning as structures are removed.

All existing stationary structures would have navigation marking and lighting in accordance with FAA, USCG, and BOEM requirements, and structures exceeding 200 feet AMSL and located within U.S. territorial waters would have been analyzed for potential impacts on air traffic at the time of construction through the review process triggered by filing Form 7460-1 (as explained in the Aviation and Air Traffic Section). Because the WTGs would be taller than 699 feet (213 meters), low intensity aviation obstruction lights would be required at mid-tower, in addition to lights on the nacelle (COP Volume III, Section 2.2.1.1; Epsilon 2020a). At 853 feet (260 meters) AMSL, the blade tips within territorial waters would be identified as obstructions through the FAA obstruction evaluation process defined in 14 CFR § 77.17(a)(1). Aeronautical studies would be conducted to evaluate potential physical or electromagnetic radiation impacts from these WTGs on the operation of air navigation facilities, including impacts on existing or proposed air navigation, communications, radar, and control systems, visual flight rules or instrument flight rule operations, airport traffic control cab views, and airport capacities (including the cumulative impact resulting from the structure when combined with the impact of other existing or proposed structures) (FAA 2020a). FAA obstacle clearance surfaces, which are level or sloping “imaginary” surfaces associated with airspace that identify the minimum required obstacle clearance (FAA 2018), are also investigated. As specified above, prior to construction, applicants for all individual structures exceeding 200 feet (61 meters) tall within U.S. territorial waters must file Form 7460-1 (Notice of Proposed Construction) with the FAA, which triggers a review to identify and resolve aviation risks through an aeronautical study. The Bay State project, located closer to ground-based radar systems than the Proposed Action, received Determinations of No Hazard for WTGs up to 320 meters (1,049 feet) AMSL. Similar to Vineyard Wind 1 Project, it is assumed that project proponents would conduct aeronautical studies as part of a project’s due diligence regardless of their position within or outside U.S. territorial waters boundaries. In addition, BOEM assumes that offshore wind project operators would coordinate with aviation interests throughout the planning, construction, operations, and decommissioning process to avoid or minimize impacts on aviation activities and air traffic.

Cables and Pipelines

Presence of structures: Three existing submarine cables and no pipelines were identified within the geographic analysis area. Installed WTGs and ESPs, and stationary lift vessels used during construction, that are located near the two existing submarine cables that cross OCS-A 0487 could pose allision risks and navigational hazards to vessels conducting maintenance activities on these cables. These two submarine cables are located within the area proposed for the Sunrise Wind Energy Facility, which is projected to be operational in 2024. Risk to cable maintenance vessels during construction and operation of the Sunrise Wind would be limited to infrequency of submarine cable maintenance required at any single location along existing cable routes. In addition, allision risks would be mitigated by FAA, BOEM, and USCG-required navigational hazard marking, and by the 1 x 1 nautical mile spacing throughout the leased areas. Risk would decrease to zero during decommissioning as structures are removed.

Construction of future wind energy facilities would add up to 775 WTGs and 20 ESPs, along with approximately 1,482 miles (2,384 kilometers) of inter-array cables and 1,310 miles (2,108 kilometers) of OECC to the RI and MA Lease Areas between 2021 and 2030. Presence of these structures could preclude additional submarine cable development—including cables for future offshore wind facilities—from the wind development areas and require future cables to route around the leased areas. Future offshore wind cables would also have to consider the location of existing cables during routing, including the South Fork Wind, Mayflower, and the Bay Wind State offshore cable. However, cables can be crossed using standard protection techniques during construction, operations, and decommissioning. During project operational timeframes, impacts on submarine cables crossed by offshore wind cables would be limited to rare occasions when maintenance work at the cable crossings would be required. Impacts on submarine cables would be eliminated during decommissioning of offshore wind farms if export cables associated with those projects are removed.

Radar Systems

Presence of structures: Operational onshore and offshore WTGs in the direct line-of-sight with or extremely close to radar systems can cause clutter and interference. Construction of future wind energy facilities would add up to 775 WTGs with maximum blade tip heights of up to 853 feet (260 meters) AMSL to the RI and MA Lease Areas between 2021 and 2030. NOAA Next Generation Weather Radar (NEXRAD) systems are located a sufficient distance from the RI and MA Lease Areas such that radar interference and mitigation would not be anticipated (COP Volume III, Section 7.9.2.1.2, Figure 7.9-1; Epsilon 2020a). Installation of WTGs within the RI and MA Lease Areas is unlikely to individually or cumulatively impact military and civilian radar systems, due to anticipated ongoing coordination between individual project operators and military, national security, civilian, and private interests. The FAA would evaluate potential impacts on aeronautical and military radar systems, as well as mitigation measures for those impacts through their review of Form 7460-1 for individual WTGs within U.S. territorial waters (as explained in Aviation and Air Traffic discussion). This analysis process in addition to independent studies conducted by project proponents are anticipated to identify potential impacts and any mitigation measures specific to radar systems for each WTG analyzed. The Bay State Wind project, located closer to ground-based radar systems than the Proposed Action, received Determinations of No Hazard for WTGs with heights of up to 1,049 feet (320 meters) AMSL.

Scientific Research and Surveys

Presence of structures: Activities associated with offshore wind development, such as site assessment activities, construction of reasonably foreseeable offshore wind farms (including placement of structures such as ESPs and WTGs), associated cable systems, and vessel activity would present additional navigational obstructions for sea and air-based scientific surveys. Using the assumptions in Table A-4 in Appendix A, construction of future wind energy facilities would add up to 775 WTGs to the RI and MA Lease Areas and 1,059 WTGs outside the New England area within the geographic analysis area between 2021 and 2030. The WTGs would have an assumed maximum blade tip height of up to 853 feet (260 meters) AMSL. Collectively, these developments would prevent continued NMFS scientific research surveys under current vessel capacities and monitoring protocols in the geographic analysis area and may reduce opportunities for other NMFS scientific research studies in the area. NMFS scientific surveys that overlap with wind development areas collectively represent over 277 survey-years of total effort by dedicated NOAA ship and aircraft resources. Data gathered from these surveys represent some of the most comprehensive data on marine ecosystems in the world, and data within offshore wind development areas are essential to those datasets in the Northwest Atlantic Ocean. These data support fisheries assessments and management actions, protected species assessments and management actions, ecosystem-based fisheries management, and regional and national climate assessments, as well as a number of regional, national, and international science activities.

Within offshore wind facility areas, survey operations would be curtailed or eliminated under current vessel capacities and monitoring protocols. Specifically, coordinators of large vessel survey operations or operations deploying mobile survey gear have currently determined activities within offshore wind facilities are not within their safety and operational limits. The need for survey vessels to navigate around large offshore wind projects to access survey stations would cause a loss of efficiency for surveys conducted outside the wind energy areas by reducing sampling time available with limited sea day allocations for survey vessels. In addition, changes in required flight altitudes due to proposed turbine height would affect aerial survey design and protocols. Stock assessment surveys for fisheries and protected species and ecological monitoring surveys considered in this analysis include, but are not limited to: the NMFS spring and fall multi-species bottom trawl surveys; the NMFS surf clam survey; the NMFS ocean quahog survey; the NMFS integrated benthic survey/Atlantic scallop survey (optical and dredge); NMFS winter, spring, summer and fall ecosystem monitoring surveys; the NMFS North Atlantic right whale photographic sightings surveys (aerial); the NMFS marine mammal, sea turtle and seabird vessel surveys; the NMFS marine mammal and sea turtle aerial surveys; the Virginia Institute of Marine Science scallop dredge survey; and the Northeast Area Monitoring and Assessment Program surveys.

Although the Northeast Area Monitoring and Assessment Program survey is within the geographic study area for cumulative impacts, there are no identified projects and actions (Draft EIS Section C.1.13) that are likely to impact this survey, since it does not overlap with the proposed Project or reasonably foreseeable offshore renewable energy projects. In the case of the NMFS surveys, BOEM acknowledges that NOAA's Office of Marine and Aviation Operations endorses the restriction of large vessel operations to greater than 1 nautical mile from wind installations due to safety and operational challenges. NOAA evaluated the effects and impacts on these survey operations based on likely foreseeable actions that include the WDA, and all other existing projects within the geographic analysis area, and the analysis is provided in Section 3.14.2.1.

3.14.1.2. Conclusions

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impacts on other uses. BOEM expects ongoing activities, future non-offshore wind development, and future offshore wind activities to have continuing impacts on military and national security uses, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys primarily through presence of structures that introduce navigational complexities and vessel traffic (Table 3.14-1).

Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in **negligible** to **minor** adverse impacts for aviation and air traffic, cables and pipelines, and radar systems; **moderate** adverse impacts for military and national security uses; and **major** adverse impacts for scientific research and surveys, based on the following:

- Impacts on military and national security uses and aviation and air traffic would primarily be caused by installation of up to 775 WTGs in the RI and MA Lease Areas, which would introduce long-term navigational complexity in the region and pose navigational hazards, increasing allision risks for vessels and collision risks for aircraft. Allision risk would be mitigated by navigational hazard marking consistent with BOEM and USCG requirements, and by implementing a proposed collaborative regional layout that arranges WTGs in 1 x 1 nautical mile apart in fixed east-to-west rows and north-to-south columns across the entire RI and MA Lease Areas. Potential risks to military and civilian aviation would be mitigated by the existing FAA review process for structures that exceed 200 feet (61 meters) tall within territorial waters, conduct of aeronautical studies by project operators, and implementation of navigational marking of structures according to FAA, USCG, and BOEM requirements. Installation of WTGs may necessitate navigational route changes at nearby airports.
- No new cables or pipelines except for offshore wind cables are anticipated to be installed within the geographic analysis area for cables and pipelines. Installation of WTGs and cabling systems within the RI and MA Lease Areas, as well as OECCs, would require future cables to route around offshore wind facilities, and increase risks to vessels conducting maintenance on existing submarine cables located in OCS-A 0487. While future offshore wind cables would need to consider the location of existing cables in routing efforts, cable crossings can be accomplished using standard protection techniques.
- Impacts on NOAA NEXRAD weather radar systems are not anticipated, due to distance between offshore wind lease areas. Identification and mitigation of potential issues with other ground-based radar systems is expected to occur through the FAA review process or independent studies conducted by project proponents. The presence of stationary structures would prevent or hamper continued NMFS scientific research surveys using current vessel capacities and monitoring protocols, and may reduce opportunities for other NMFS 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 proposed WTG height would affect aerial survey design and protocols. BOEM acknowledges that NOAA's Office of Marine and Aviation Operations endorses the restriction of large vessel operations to greater than 1 nautical mile from wind installations due to safety and operational challenges.

3.14.2. Proposed Action and Action Alternatives

3.14.2.1. Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on other uses were described in Draft EIS Section 3.4.8.3, and additional information is included in Table 3.14-1. Changes to the design capacity of the WTGs proposed in the Vineyard Wind COP (Epsilon 2020a), as compared to the WTGs evaluated in the Draft EIS, would not alter the maximum impact scenario for other uses for the Proposed Action and all other action alternatives. The analysis contained in this section for military and national security uses, aviation and air traffic, cables and pipelines, and radar systems, and scientific research and surveys is based on a maximum-case impact scenario of 57 14-MW WTGs, as described in the Vineyard Wind COP. The maximum height of the blade tips of 14 MW turbines proposed in the Vineyard Wind COP exceed the heights described in the Draft EIS by 147 feet (44.8 meters). If Vineyard Wind were to install 57 14-MW WTGs instead of the potential 100, 8-MW WTGs initially evaluated, the reduced number of structures and vessel traffic associated with construction and operation would affect other uses as follows:

- Impacts on military and national security uses would increase overall. Although 43 fewer WTGs would be constructed, decreasing the number of WTGs within the WDA, and decreasing vessel traffic associated with construction, operations, and decommissioning, impacts on military and national security uses related to military air traffic would increase because maximum height of WTG blade tips would increase by approximately 147 feet (44.8 meters), WTGs would require additional mid-tower navigation hazard marking, and the proposed Project could require additional changes to air traffic patterns. These differences would not materially change impact ratings for military vessel or air traffic.
- Impacts on aviation and air traffic would increase. Although 43 fewer WTGs would be constructed and the size of the developed area within the WDA would remain the same. However, the maximum height of the WTG blade tips would increase by approximately 147 feet (44.8 meters), WTGs would require additional mid-tower navigation hazard marking, and the proposed Project could require additional changes to air traffic patterns. These differences would not materially change impacts ratings for military air traffic.
- Impacts on future cables and pipelines would remain the same. Although 43 fewer WTGs would be constructed, the size of the developed area within the WDA, and therefore the size of the area that would need to be avoided for future cables and pipelines, would remain the same.
- Impacts on radar systems would slightly increase. Although there would be 43 fewer WTGs and the development area would remain the same, and WTGs would be taller, creating a potentially larger radar signature.
- Impacts on scientific research and surveys would remain the same. Although there would be fewer WTGs, the development area would remain the same and survey strata and operations would be similarly impacted.

In general, reducing the number of WTGs to 57 and installing taller 14 MW turbines would change impacts on other uses slightly, primarily due to reduction of number of WTGs, but would not materially change impact findings identified in the Draft EIS. Increasing the size of the proposed substation by 2.2 acres (less than 0.1 km^2), as described in Chapter 2, would not change the analysis of impacts on other uses for the Proposed Action and all other action alternatives included in the Draft EIS, due to the small acreage affected.

The direct and indirect impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are listed by IPF in Table 3.14-1. The most impactful IPFs are presence of structures and increased vessel traffic.

The nature of the primary IPFs affecting other uses, and the cumulative impacts including the Proposed Action, would be of the same types described in Sections 3.14.1.1 and 3.14.1.2, but may differ in intensity and extent. If the Vineyard Wind 1 Project is not approved, it is assumed that the energy demand that the Vineyard Wind 1 Project would have filled would likely be met by other projects in remaining areas of the Massachusetts, Rhode Island, and/or New York leases. Although the impacts from a substitute project may differ in location and time, depending on where and when offshore wind facilities are built out to meet the remaining demand, the nature of impacts and the total number of WTGs would be similar either with or without the Proposed Action, as described in Section 3.14.1. In other words, future offshore wind facilities capable of generating 9,404 MW would be built in the RI and MA lease areas, although, in the absence of the Proposed Action, none would be built before 2021. Therefore, the cumulative impacts related to WTGs would generally be equal to those described in Section 3.7.1.1.

Military and National Security Uses

Presence of structures: Existing risks of allisions in the open waters of the geographic analysis area are low due to lack of stationary structures. The Proposed Action would add up to 59 stationary structures (up to 57 WTGs and 2 ESPs) to the WDA during construction and operations, and would also utilize stationary lift vessels in the WDAs and cranes in ports during construction. WTG blade tips would have a maximum height of up 837 feet (255 meters) AMSL. Navigational complexity in the area within and around the WDA would increase as structures are installed during construction or along transit routes, and decrease during project decommissioning. The proposed Project would increase navigational complexity and risks within the WDA, and cumulative impacts from other offshore wind projects would be similar but located in the individual project lease areas as described in Appendix A. The Department of Defense concluded that the Proposed Action would have minor but acceptable impacts on their operations (F. Engel, Pers. Comm., 2018); however, this determination does not include USCG's activities such as SAR. These potential impacts include:

- **Increased risk of military or national security vessel allisions with stationary structures:** The addition of up to 57 WTGs and up to 2 ESPs would increase risk of allisions for military vessels for 30 years during project operations. Use of stationary lift vessels within the WDA during construction would also increase allision risk. Military traffic within the WDA is relatively low (four vessels recorded in 2016 and 2017), and deep-draft military vessels are not anticipated to navigate outside of navigation channels unless necessary for SAR operations. Generally, the vessels more likely to allide with WTGs or ESPs would be smaller vessels moving within and near wind installations. Deep draft military and national security vessels near traffic separations schemes or port entrances could potentially lose power and allide with a nearby WTG. Allision risks could be mitigated by WTG spacing at 1 x 1 nautical mile apart. Vineyard Wind would coordinate with military and national security interests to minimize impacts during construction, operations, and decommissioning. Allision risk would be eliminated after decommissioning when structures are removed. Overall, presence of the Proposed Action's stationary structures would cause localized, long-term, **minor** to **moderate** impacts from allision risk.

  Stationary structures associated with ongoing activities and future non-offshore wind activities that increase allision risks are widely dispersed in the open ocean within the geographic analysis area, and limited to the five offshore wind turbines associated with the Block Island Wind Farm, deployed meteorological buoys associated with the offshore wind site assessment activities, and shoreline developments such as docks. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but more extensive, with up to 775 WTGs and 20 ESPs constructed within the RI and MA Lease Areas before 2030. Cumulatively, the impacts of the Proposed Action on military and national security uses from increased allision risk when combined with past, present, and reasonably foreseeable projects would be localized, long-term, and **minor** to **moderate**.
- **Increased risk of collisions between military vessels and recreational vessels attracted to stationary structures**: Construction of the Proposed Action would add 57 WTGs and 2 ESPs that could create an artificial reef effect, attracting species of interest to recreational fishing or sightseeing, attracting additional recreational fishing and sightseeing vessels that would be additive to existing vessel traffic in the area. The presence of additional recreational vessels would add to conflict or collision risks for military and national security vessels, and could increase demand for SAR operations. Military traffic within the WDA is relatively low (four vessels recorded in 2016 and 2017), and military vessels are not anticipated to navigate outside of navigation channels unless necessary for SAR operations. Risk would increase during operations when stationary structures are installed, and recreational fishing vessels can access the development area. Overall, presence of stationary structures that attract species of interest to recreational fishing or sightseeing within the WDA would cause localized, long-term, **minor** impacts from allision risk. Existing stationary structures associated with ongoing and future non-offshore wind activities that act attract species of interest to recreational fishing or sightseeing include the Block Island Wind Farm and shoreline developments such as docks. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but more extensive, with up to 775 WTGs and 20 ESPs proposed to be constructed within the RI and MA lease areas before 2030. Cumulatively, the impacts on military and national security uses from navigational hazards would be localized, long-term, and **minor**.
- **Increased risk to military vessels and aircraft due to increased navigational complexity:** Construction of the Proposed Action would add 57 WTGs with maximum blade tip heights of up to 837 feet (255 meters) AMSL and up to 2 ESPs within the WDA, and would necessitate use of stationary lift vessels within the WDA and cranes in ports during construction, increasing navigational complexity and changing navigational patterns for vessels and aircraft operating in the area around the WDA. Increased navigational complexity would increase the risk of collisions and allisions for military and national security vessels or aircraft within the WDA. Structures would be marked as a navigational hazard per FAA, BOEM, and USCG requirements, and risk would be consistent within the 30-year operational period. The WTGs are anticipated to be visible on radar systems of low-flying military and national security aircraft, and would appear similar to other large-scale sea surface activity on radar systems. Nonetheless, the Proposed Action's structures and layout (i.e., lacking 1 x 1 nautical mile spacing and not aligned in east-west rows and north-south columns) could make it more difficult for SAR aircraft to perform operations in the lease area, leading to less effective search patterns or earlier abandonment of searches. This could lead to increased loss of life due to maritime incidents. As part of the proposed Project, Vineyard Wind would voluntarily implement a strict operational protocol with the USCG that requires the WTGs to stop rotating within a specified time to mitigate impacts to search and rescue aircraft operating in the WDA (COP Volume III, Section 7.8.2.2.3; Epsilon 2020a). The Project filed FAA Form 7460-1 for WTGs located

in territorial waters with a maximum height of 212 meters (696 feet) and received Determinations of No Hazard. Prior to construction, Vineyard Wind would refile Form 7460-1 (Notice of Proposed Construction) with the FAA for all temporary and permanent structures exceeding 200 feet (61 meters) tall within territorial waters, including the WTGs. This filing would trigger another review and updated aeronautical studies to identify and resolve potential airspace conflicts. The FAA would invite military and national security interests to review and comment on each Form 7460-1 filing submitted. Vineyard Wind would ensure that a Marine Coordinator remains on duty for the life of the Proposed Action to liaise with the military and national security interests to reduce potential conflicts. The navigational hazard would be gradually eliminated during decommissioning as structures are removed. Overall, the presence of stationary structures in the grid pattern described for the Proposed Action would cause localized, long-term, **moderate** impacts from increased navigational complexity and associated risks.

Stationary structures associated with ongoing and future non-offshore wind activities would continue to be added primarily onshore and include communications towers, onshore WTGs, and other developments. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but more extensive, with up to 775 WTGs and 20 ESPs proposed to be constructed within the RI and MA Lease Areas before 2030. All onshore or offshore structures located within U.S. territorial waters that exceed 200 feet (61 meters) in height (such as wind turbines and communication towers) would require submittal of Form 7460-1 to the FAA, and the Department of Defense and Department of Homeland Security would be invited to comment through the FAA review process. The Bay State Wind project, located closer to ground-based radar systems than the Proposed Actions, received Determinations of No Hazard for WTGs with heights up to 1,049 feet (320 meters) AMSL within U.S. territorial waters. Similar to Vineyard Wind 1 Project, it is assumed that project proponents would conduct aeronautical studies to identify and resolve any aviation-related conflicts as part of a project's due diligence, regardless of their position within or outside U.S. territorial waters boundaries. Cumulatively, the impacts on military and national security uses form this sub-IPF would be localized, long-term, and **major**.

- **Increased risk of space use conflicts:** Changing navigational patterns could cause space use conflicts as military and national security vessels, commercial vessels, and recreational vessels route around the WDA. Military traffic within the WDA is relatively low (four vessels recorded in 2016 and 2017). Warning area W-105A overlies the majority of the WDA. Because the authorized altitude associated with this segment of airspace begins at the sea surface, the addition of 57 WTGs within the WDA could impact operations within the 15 acres (out of 23,000 total square miles) of W-105A within the WDA. Vineyard Wind would ensure that a Marine Coordinator remains on duty for the life of the Proposed Action to liaise with the military and national security interests to reduce potential conflicts. Risks would be eliminated gradually during decommissioning as stationary structures are removed. Overall, presence of stationary structures within the WDA would cause localized, long-term, **minor** impacts from increased space use conflicts.

  Stationary structures associated with ongoing activities and future non-offshore wind activities would continue to be added primarily onshore, and would typically include communications towers, onshore WTGs, and other developments. Collectively, onshore developments could cause additional space use conflicts with onshore military activities. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but more extensive, with up to 775 WTGs and 20 ESPs proposed to be constructed within the RI and MA Lease Areas before 2030. As multiple projects are built, changing navigation patterns could concentrate vessels within designated navigation corridors and around the outsides of the RI and MA Lease Areas, potentially causing space use conflicts in these areas and increasing the risk of collisions with between military and national security vessels, commercial vessels, and recreational vessels. Offshore wind development could cumulatively impact military and national security operations conducted within the warning area W-105A, but impacts are anticipated to be minor with approximately 15 square miles of the warning area overlapping the MA lease areas. Cumulative impacts on military and national security uses form this sub-IPF would be localized, long-term, and **minor**.
- **Risks of collisions between military vessels and vessels conducting export cable construction and maintenance:** Cable construction vessels associated with the Proposed Action could cause military and national security vessels to change route or navigate around temporarily active construction sites above cables. Maintenance of the cables during the 30-year operational period is anticipated to be infrequent. Vineyard Wind would continue coordination with military and national security interests to minimize conflicts in active construction or maintenance areas. Impacts on military and national security uses at any one site along the cable route would be localized, temporary, and **negligible**.

  Ongoing activities and future non-offshore wind activities are limited to infrequent maintenance events along existing submarine cables within the geographic analysis area. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but at the locations of the Vineyard Wind 2, Mayflower Wind, South Fork Wind, a development by Equinor Wind, and the Bay State Wind cables, and currently unknown cable routes associated with other lease areas offshore Massachusetts and Rhode Island. Construction of cable routes associated with other offshore wind projects would likely be staggered temporally beginning in 2022 and continuing through 2030, further minimizing risk to military operations. Cumulatively, impacts on military and national security from the presence of cables would be localized, temporary, and **negligible**.

Overall, the Department of Defense reviewed the Proposed Action in its entirety and concluded that it would have **minor** but acceptable impacts on their operations; however, the impacts would be **moderate** for USCG SAR. The Navy has informed Vineyard Wind that the Vineyard Wind 1 Project does not raise concerns for their military operations (COP Volume III, Section 2.2.1.1; Epsilon 2020a). As part of the proposed Project, Vineyard Wind will voluntarily employ a Marine Coordinator for the life of the Proposed Action to liaise with the military and national security interests to reduce potential conflicts. Vineyard Wind and the USCG would provide Offshore Wind Mariner Updates and Notice to Mariners that describe Vineyard Wind 1 Project-related activities that may be of interest to military and national security interests, including Navy aircraft and vessels operating within the Vineyard Wind 1 Project region. It is assumed that other offshore wind operators would also act to coordinate with military and national security interests throughout construction, operations, and decommissioning, and act to mitigate individual project and cumulative impacts of offshore wind development.

Vessel traffic: Vessel traffic associated with construction and decommissioning of the Proposed Action could cause military and national security vessels to change routes, and could cause congestion and delays in port and within transit routes. Vineyard Wind would coordinate with the Navy and USCG during all phases of the proposed Project to minimize conflicts within the WDA, along transit routes, and within ports. The offshore components of the Proposed Action would be monitored and controlled remotely from the Proposed Action's Operations and Maintenance Facilities. During the operational phase, planned maintenance activities would involve dispatching a crew transport vessel to complete repairs and restore normal operations. These activities would be similar to existing civilian vessel activity in and near the WDA, and Vineyard Wind would comply with coordination requirements. Military traffic within the WDA is relatively low (four vessels recorded in 2016 and 2017); therefore, operational conflicts are not anticipated within the WDA. Impacts on military and national security from Proposed Action-related vessel traffic would be localized, temporary, and **minor** during construction and decommissioning, and **negligible** during operations. Cumulatively, impacts are most likely to occur during construction and decommissioning timeframes and would be localized, temporary, and **minor**.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from **negligible** to **major**. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action and past, present, and reasonably foreseeable activities would result in **major** impacts on military and national security uses in the geographic analysis area. The main drivers for this impact rating are installation of structures, primarily WTGs, within the RI and MA Lease Areas that would hinder USCG SAR operations, leading to increased loss of life. The Proposed Action would contribute to the overall impact rating primarily through the installation of WTGs and ESPs within the WDA, and to a lesser extent through the addition of Project-related vessels to current vessel traffic between ports and the WDA. Military entities have reviewed the Proposed Action and have not identified moderate or major conflicts; Vineyard Wind's Marine Coordinator would liaise with military and national security interests to reduce potential conflicts throughout construction, operations, and decommissioning of the Proposed Action. The types of cumulative impacts would be highly similar under the No Action Alternative or under the Proposed Action, with structures installed across the RI and MA Lease Areas. The overall cumulative impacts on military and national security uses would likely qualify as **major** due to presence of structures.

Aviation and Air Traffic

Presence of structures: Construction of the Proposed Action would add 57 WTGs with maximum blade tip heights of up to 837 feet (255 meters) AMSL to the WDA. Addition of these structures would increase navigational complexity and change aircraft navigation patterns in the area around the WDA, increasing collision risks for low-flying aircraft during the Proposed Action's operational timeframe. More than 90 percent of existing air traffic over the WDA occurred at altitudes that would not be impacted by the presence of WTGs. Pilots who choose to fly at lower altitudes over open ocean near the WDA would have to alter routes to avoid potential collisions with WTGs. The WTGs would have navigational markings and lighting pursuant to FAA and BOEM requirements, and would be visible on the radar systems of low-flying aircrafts, similar to other large-scale sea surface activity.

The proposed 14 MW 837-foot (255-meter) blade tip height could necessitate changes to navigation patterns for airports in the region such as Nantucket Memorial Airport and Martha's Vineyard Airport, as well as for the Boston Consolidated and Providence Terminal Radar Approach Control sectors, and a Boston Air Route Traffic Control Center Minimum Instrument Flight Rule Altitude sector. Such changes would be initiated by the FAA, and could impact approximately the 10 percent of air traffic that flies over the WDA at altitudes that could be affected by the Proposed Action. The remaining 90 percent of the existing air traffic over the WDA occurred at heights above 1,500 feet AMSL (COP Volume III, Section 7.9.2.1.2; Epsilon 2020a), and thus would not be affected. The Project filed FAA Form 7460-1 for WTGs located in territorial waters with a maximum height of 212 meters (696 feet) and received Determinations of No Hazard. Prior to construction, Vineyard Wind would refile Form 7460-1 Notice of Proposed Construction for all individual structures in territorial waters exceeding 200 feet (61 meters) tall, including the 14-MW WTGs. The filing would trigger another review to identify and resolve aviation risks through updated aeronautical studies, with consideration of existing obstacles in FAA records. As part of the proposed Project, Vineyard Wind will voluntarily employ a Marine Coordinator for the life of the Proposed Action to liaise with the military and national security interests to reduce potential conflicts. While the WTGs in combination with other existing or proposed tall structures onshore and offshore would cumulatively increase navigational complexity in the area and potentially necessitate changes to air navigation patterns, the FAA has established methods for marking potential obstructions, mitigating potential impacts, and notifying aviation interests about any changes to airspace management. Implementation of these standard procedures would reduce risks associated with cumulative impacts from structures on aviation and air traffic. Navigational hazards and collision risks would be gradually eliminated during decommissioning as structures are removed. Overall impacts on aviation and air traffic from the Proposed Action would be localized, long-term, and **minor**.

Existing stationary structures including the five Block Island wind turbines and communications towers would contribute to cumulative impacts, and future stationary structures not associated with offshore wind activities would continue to be added primarily onshore, including communications towers, onshore WTGs, and other developments. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but increased with up to 775 WTGs with maximum blade tip heights of up to 853 feet (260 meters) AMSL proposed to be constructed within the RI and MA Lease Areas before 2030. As described above, construction of structures exceeding 200 feet (61 meters) in height (such as wind turbines and communication towers) within U.S. territorial waters triggers FAA reviews, through which necessary changes to navigational patterns are identified and implemented. The Bay State Wind project, located closer to ground-based radar systems than the Proposed Actions, received Determinations of No Hazard for WTGs with heights up to 1,049 feet (320 meters) AMSL within U.S. territorial waters. Similar to the proposed Project, it is assumed that project proponents would conduct aeronautical studies to identify and resolve any aviation-related conflicts as part of a project's due diligence regardless of their position within or outside U.S. territorial waters boundaries. As a result, the cumulative effects associated with the Proposed Action and past, present, and reasonably foreseeable activities would result in regional, long-term, and **minor** impacts on aviation and air traffic uses from this IPF. Overall impacts are classified as **minor** because air traffic would be able to continue over and around the RI and MA Lease Areas after any required changes to air traffic navigation patterns are made through established processes.

Cables and Pipelines

Presence of structures: There are no existing submarine cables or pipelines located within the WDA. If the New Hampshire Avenue landfall site is selected for cable landfall, the OECC would cross the National Grid Hyannis Port-Jetties Beach submarine power cable off Dunbar Point. Construction of the Proposed Action would add 57 WTGs and 2 ESPs within the WDA, but are not likely to pose an allision risk to vessels conducting maintenance activities at existing submarine cables near the WDA. Such vessels could route around or through the WDA, but impacts such as allision would be rare due to infrequency of submarine cable maintenance. Presence of the 57 WTGs and 2 ESPs, and an inter-array cabling system within the WDA, could preclude future submarine cable development through the WDA. Future submarine cables, including future offshore wind export cables, would need to be routed around the WDA during the operational timeframe. Space use conflicts could be eliminated during decommissioning if structures are removed. The proposed Project would use standard techniques during construction, operations, and maintenance to prevent damage to the National Grid Hyannis Port-Jetties Beach submarine power cable if the New Hampshire Avenue landfall site is selected. Impacts on this cable during project operations would be infrequent and limited to times when work at the cable crossings would be required. Impacts would decrease to zero after decommissioning if cables are removed. Cables can be protected by standard techniques during construction, operations, and decommissioning; therefore, overall impacts on cables are anticipated to be localized, long-term, and **negligible**.

Ongoing maintenance of existing submarine cables, including the Block Island Wind Farm OECC and two submarine cables located in the western portion of OCS-A 0487, would continue into the future, and future offshore wind activities would restrict future cable placement within developed areas of the RI and MA Lease Areas. Several submarine cables and no pipelines were identified within the geographic analysis area. Two cables cross the far western portion of OCS-A 0487 within the area proposed for the Sunrise Wind, which is projected to be operational in 2024. These cables are associated with a larger network of submarine cables that are located south of the cumulative lease areas and make landfall near Charlestown, Massachusetts. Cable maintenance vessels transiting through the leased areas, and vessels conducting infrequent maintenance on the two submarine cables that cross OCS A 0487 would be at risk of allisions, but risk would be mitigated by required navigational hazard marking and implementation of a 1 x 1 nautical mile spacing throughout the leased areas. Future cables may be precluded from all developed areas within the RI and MA Lease Areas after installation of WTGs, ESPs, and inter-array cabling systems because cables can be protected by standard techniques during construction, operations, and decommissioning. Therefore, the overall cumulative impacts are anticipated to be localized, long-term, and **negligible** because impacts can be avoided by standard cable protection techniques.

Radar Systems

Presence of structures: Construction of the Proposed Action would add up to 57 WTGs with maximum blade tip heights of up to 837 feet (255 meters) AMSL height to the WDA during the construction period. Ground-based radar systems are located a sufficient distance from the WDA that radar interference is not anticipated and mitigation would not be required. A U.S. Department of Energy screening tool for WTG siting did not identify any potential conflicts between the Proposed Action and ground-based NOAA NEXRAD weather radars (COP Volume III, Section 7.9.2.1.2; Epsilon 2020a). Any impacts on long-range radar systems are anticipated to be mitigated by overlapping coverage and radar optimization (COP Volume III, Section 7.9.2.2.6; Epsilon 2020a). The FAA would evaluate potential impacts on radar systems, as well as mitigation measures for those when Vineyard Wind refiles Form 7460-1 for individual WTGs). Vineyard Wind's Marine Coordinator would remain on duty for the life of the Proposed Action to liaise with military, national security, civilian, and private interests to reduce potential radar conflicts. Impacts on radar systems from the Proposed Action are anticipated to be localized, long-term, and **minor**.

Impacts on radar systems from existing structures exceeding 200 feet in height within U.S. territorial waters would have been identified through the FAA Form 7460-1 filing process, and any future non-offshore wind and offshore wind structures exceeding 200 feet in height within U.S. territorial waters must follow the same process. Future offshore wind project operators would file a Form 7460-1 for each WTG proposed to be located within the territorial waters, and the analysis process would identify potential impacts and any mitigation measures specific to aeronautical and military radar systems for each WTG filled. The Bay State Wind project, located closer to ground-based radar systems than the Proposed Action, received Determinations of No Hazard for WTGs with heights up to 1,049 feet (320 meters) AMSL within U.S. territorial waters. Similar to proposed Project, it is assumed that project proponents would conduct aeronautical studies to identify and resolve any aviation-related conflicts as part of a project's due diligence regardless of their position within or outside U.S. territorial waters boundaries. Projects located further offshore are less likely to impact ground-based radar systems. BOEM anticipates that potential individual and cumulative impacts on radar systems from other onshore and offshore wind projects would be identified and mitigated through the FAA 7460-1 review process or by individual reviews conducted by project proponents; therefore, the overall cumulative impacts on radar systems would be localized, long-term, and **minor** and potential conflicts address through established processes.

Scientific Research and Surveys

Construction of the Proposed Action would add up to 57 WTGs with maximum blade tip heights of up to 837 feet (255 meters) AMSL height to the WDA during the construction period. Construction of the Proposed Action and other foreseeable offshore wind projects would add an estimated 775 WTGs to the RI and MA Lease Areas and 1,059 WTGs outside the New England area, with a maximum height of 853 feet (260 meters) AMSL. The following provides NOAA's evaluation of the potential impacts on these survey operations based on likely foreseeable actions, including the WDA and all other existing federal lease areas from Maine to mid-North Carolina.

Fish and shellfish research programs: Randomized station selection methodologies that are employed by most of the shipboard scientific fish and shellfish surveys would not be able to be applied in wind energy areas. Loss of survey areas would increase the uncertainty in estimates of fish and shellfish stock abundances and of oceanographic parameters. If abundances, distributions, biological rates, or environmental parameters differ inside versus outside wind energy areas but cannot be observed, resulting survey indices could be biased and unsuitable for monitoring stock status. Similarly, resulting regional oceanographic time series could also be biased. A broad analysis for the NMFS bottom trawl surveys that considered current and planned wind areas found that 9 out of 14 offshore strata that contribute most of the area sampled in the Southern New England Mid-Atlantic region would likely be affected. Strata for fish and shellfish surveys are defined based on depth and alongshore features, to delineate areas of relatively homogeneous species distributions. Random sampling within a stratum is a key attribute of statistical performance of these and many other typical survey designs.

The Vineyard Wind lease area alone overlaps strata associated with three different coast-wide Northeast Fisheries Science Center fishery resource monitoring surveys. For the spring and fall multi-species bottom trawl surveys, 6 percent of the area in one stratum would be within the Vineyard Wind lease area. For the ocean quahog survey, 3 percent of the area in one stratum would be within the lease area. As a result, the Proposed Action would result in **major** impacts on NOAA's scientific surveys.

The effects of other offshore wind projects would be similar, over an extended area. For the spring and fall multi-species bottom trawl surveys, 16 of the Southern New England—Mid-Atlantic strata would be affected, although overlap is less than 1 percent in 2 strata. Between 3 and 60 percent of each remaining 14 stratum's area would be covered by offshore wind lease areas, including the Proposed Action. The percent of area made unavailable would be higher in inshore strata (mean of 18 percent) than offshore strata (mean of 11 percent). Of the fourteen offshore strata that contribute most of the area surveyed in the region, nine are affected. In the case of Offshore Stratum 9, for example, which includes the Proposed Action and contiguous lease areas, up to 37 percent of the area could be unsampleable. For the integrated benthic/Atlantic sea scallop survey, four routinely sampled strata would likely be affected, with 3 to 12 percent of the stratum areas potentially unsampleable. For another two strata that are intermittently dredge sampled through the Virginia Institute of Marine Science Research Set Aside program, 21 to 56 percent of the area within those two strata would potentially be unsampleable. For the ocean quahog survey, four out of twelve strata would include offshore wind lease areas, with 3 to 19 percent of the stratum areas potentially unsampleable. For the surfclam survey, three out of twelve survey strata would include offshore wind lease areas, with 7 to 14 percent of the stratum areas potentially unsampleable. Low percentage overlaps for these two shellfish surveys may still have substantial effects, because there are only a few large strata in both surveys. Areas occupied by OECCs, which could not be trawled or dredged, are not included in these estimates. In summary, depending on the survey, up to 33 percent of strata within a survey would potentially be affected, and up to 60 percent of a single stratum within a survey would potentially be affected.

As noted above, removing survey effort to remaining areas that can be sampled would not mitigate the effects. Without new alternative sampling methods and statistical designs, relocation of survey efforts would affect sampling accuracy. In addition, impacts could extend to operations outside wind energy areas, decreasing remaining survey precision. Based on layout and spacing of WTGs and current survey vessel operation policies, NMFS-supported vessels would not transit through wind energy lease areas. Alteration of survey vessel routes and resultant increased travel times would reduce survey productivity and precision.

Protected species (cetaceans, sea turtles, and pinnipeds) research programs: Aerial survey track lines at the altitude used in current cetacean and sea turtle abundance surveys (600 feet AMSL) could not occur in offshore wind areas, because the planned maximum-case scenario WTG blade tip height (837 feet AMSL for the Proposed Action and 853 feet AMSL for other projects) would exceed the survey altitude with current surveying methodologies. The increased altitude necessary for safe survey operations could result in lower chances of detecting marine mammals and sea turtles, especially smaller species. At a minimum, NOAA Office of Marine and Aviation Operations pilots maintain a safety zone of at least 500 vertical feet from structures and hazards. The RI and MA Lease Areas comprises less than 1.5 percent of the aerial survey stratum, although the visual aerial abundance surveys for this stratum, contributes to the estimates of 30 or more stocks of cetaceans and sea turtles. Thus, if animal distribution is not affected by offshore wind activities and NMFS surveys do not include these areas, the reduction in survey stratum area would have a minimal effect on abundance estimates for protected species. Impacts would be more substantial if the distribution and/or abundance within the wind lease areas was different than the surrounding areas that continue to be surveyed.

Considerable survey efforts have been underway for years using digital aerial surveys for protected species in offshore wind areas. NMFS has begun investigating whether photographic abundance/monitoring surveys flown at a higher altitude are practical, reliable, and result in appropriately accurate and precise distribution and abundance estimates. More work is needed to confirm whether higher-altitude photographic survey methods are appropriate for abundance and monitoring surveys for all cetaceans, pinnipeds, and sea turtles.

A recent study found that the seven contiguous lease areas offshore Massachusetts and Rhode Island encompass important habitat that is utilized by NARWs (Leiter et al. 2017). Over one third of the current population, including up to 30 percent of known calving females, visited the RI and MA Lease Areas between 2010 and 2015. NMFS uses aerial surveys to collect photographs of the NARWs and other species to estimate abundance and monitor the health and status of individuals and populations. Shipboard surveys and small boat work also collect detailed data on NARWs, including photographs and drone images, biopsy samples, fecal samples, acoustic recordings, and other data types. Prey sampling in the vicinity of NARWs and in areas where they are not aggregating is being used to better characterize the habitat drivers behind their distribution. Finally, passive acoustic technology is used to monitor the presence of vocally active NARWs and other endangered large whale species throughout sites along the U.S. east coast.

Development of offshore wind in the RI and MA Lease Areas would impact approximately 60 percent of the NARW aerial survey blocks in the area. NARW aerial surveys are currently conducted at 1,000 feet AMSL, but would need to be conducted at higher altitudes to provide safety margins, as discussed above. The inability to continue flights at current altitudes (600 or 1,000 feet AMSL) over offshore wind areas would have a significant effect on the ability to use current data collection techniques to monitor the distribution and abundance of marine mammals and sea turtles that may be caused or are related to offshore wind. Alternative techniques to monitor these species could include high altitude photographic surveys, passive acoustic monitoring, and data collection on small vessels (including those used by the industry) that can safely navigate within the wind turbines.

The inability to implement shipboard surveys in current NARW habitat in offshore wind areas could significantly affect NMFS' ability to monitor the health, status, and behavior of individuals within this region, as well as NMFS' ability to monitor changes in prey distribution and other factors affecting NARW habitat use. With the operational restrictions on NOAA vessels entering developed lease areas, smaller vessels would be required to enter the area, which could lead to changes in survey methodology, available tools, and appropriate staffing of shipboard fieldwork. This could lead to less effective and efficient on-water data collection. Finally, the impact on collecting passive acoustic data in the region once offshore wind projects are developed is unknown. The use of autonomous vehicles, such as gliders, has been an important component in NMFS' near-real-time monitoring of NARW distribution, and the use of archival recorders has been important for documenting habitat use over time. It is unclear how this would change after the installation of WTGs, whether these data collection methodologies would still be feasible in these areas, and how noise from operations (i.e., construction or vessel noise from long-term turbine maintenance) would affect NMFS' ability to continue to acoustically detect animals reliably. In summary, additional work is needed to develop and implement appropriate strategies to collect, analyze, interpret, and share data to monitor the effects of wind energy activities on all protected species.

Summary: NMFS Northeast Fisheries Science Center would require additional resources to evaluate options and design and implement survey adaptations to account for offshore wind facilities in their survey study areas. Potential challenges would include identification of appropriate sampling protocols and technology, development and parameterization of new statistical survey models, and calibration of new approaches to existing ones in order to continue to sample within areas occupied by turbine foundations and submarine cables. BOEM is committed to working with NOAA towards a long-term solution to account for changes in survey methodologies as a result of offshore wind farms.

Significant resources would be required to quantify and account for the complexity and scope of effects and impacts on NMFS core scientific surveys and the management advice that rely on these surveys. However, preliminary analyses of the effects on survey areal coverage shows substantial impacts on NMFS' ability to continue using current methods to fulfill its mission of precisely and accurately assessing fish and shellfish stocks for the purpose of fisheries management, and assessing protected species for the purpose of protected species management. Changes to existing survey methodologies or disruption to the long-term survey time series of fish and shellfish would have implications for stock assessments by increasing uncertainty in biomass estimates and other parameters used in projecting fishery quotas. Uncertainty in estimating fishery quotas could lead to unintentional underharvest or overharvest of individual fish stocks, which could have both indirect beneficial and adverse impacts on fish stocks, respectively. Based on existing regional Fishery Management Councils' acceptable biological catch control rule processes and risk policies (e.g., 50 CFR § 648.20 and 21), increased assessment uncertainty would likely result in lower commercial quotas that may reduce the likelihood of overharvesting and mitigate associated biological impacts on fish stocks. However, such lower quotas would result in lower associated fishing revenue that would vary by species, which could result in indirect impacts on fishing communities. Development of new survey technologies, changes in survey methodologies, and required calibrations could help to mitigate losses in accuracy and precision of current practices due to the impacts of wind development on survey strata.

Overall, the Proposed Action would have major effects on scientific research and surveys, potentially leading to indirect impacts on fishery participants and communities (Sections 3.7.2 and 3.11.2); as well as potential major impacts on monitoring and assessment activities associated with recovery and conservation programs for protected species.

BOEM anticipates that the cumulative impacts associated with the Proposed Action would have major impacts on NMFS' scientific research and surveys and the resulting stock assessments, which could lead to potential beneficial and adverse indirect impacts on fish stocks when management decisions are based on biased or imprecise estimates of stock status. The Proposed Action would contribute to the overall impact rating primarily through placement of structures in the long-term within the WDA that pose navigational hazards to survey aircraft and vessels and restrict access to survey locations, thus impacting statistical design of surveys and causing a loss of information within the wind development areas as previously described. Impacts of the Proposed Action are similar to those of other reasonably foreseeable offshore wind development, but cumulative effects would be spread across the cumulative development areas within the RI and MA Lease Areas, affecting additional survey strata and survey areas. The overall cumulative impacts on 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, and the commercial fisheries community.

3.14.2.2. Cumulative Impacts of Alternatives B, C, D1, and E

The direct and indirect impacts of Alternatives B, C, D1, and E on other uses are described in Draft EIS Sections 3.4.8.3 through 3.4.8.7. These impacts, revised to reflect the use of 14-MW WTGs, are summarized below:

- The difference between Alternative B and the Proposed Action is the selection of Covell's Beach as the landfall site and reduction of the impacts due to the shorter OECC and avoidance of the National Grid Hyannis Port-Jettis Beach submarine cable route crossing associated with the New Hampshire Avenue landing site. The direct and indirect impacts of Alternative B on military and national security uses, aviation and air traffic, and radar systems would be the same as those of the Proposed Action, but with slightly reduced exposure to risks associated with cable construction and maintenance activities because of the shorter OECC route.
- The direct and indirect impacts of Alternative C would be similar to the Proposed Action for cables and pipelines, radar systems, and scientific research and surveys. Implementation of Alternative C could slightly increase impacts on military and national security vessel traffic and air traffic by moving additional turbines into military warning area W-105A. Alternative C could potentially decrease impacts on air traffic and aviation by moving WTGs farther away from regional airports and associated obstacle clearance surfaces, and placing WTGs where obstacle clearance surfaces are higher in elevation (COP Volume III, Appendix III-J; Epsilon 2020a). Moving the WTGs farther to the south would still require similar measures to accommodate the

proposed Project—including coordination with military and national security entities, and changes to air traffic navigational patterns—and the overall level of impact would not change.

- Alternative D1 would increase the size of the WDA and require different navigation routes for vessels within the WDA, and would implement a 1 x 1 nautical mile spacing between each WTG, but would not alter the Proposed Action's northeast-southwest/northwest-southeast grid orientation. While risks associated with vessel allisions, vessel-related navigation hazards, and space use conflicts on the water may be reduced, measures to accommodate the proposed Project would not change.
- The difference between Alternative E and the Proposed Action is the installation of between 57 and 84 WTGs of varying individual capacities, with a total Proposed Action capacity of 800 MW. If a larger number of smaller-capacity WTGs are selected (i.e., 84, 9- to 10-MW WTGs), the number of installed structures within the WDA would increase but turbines would be shorter in height. The impacts of construction, operations, maintenance, and decommissioning of Alternative E on other uses would be the same for cables and pipelines, but incrementally somewhat smaller than the revised Proposed Action for military operations and national security, aviation and air traffic, radar systems, and scientific research and surveys due to use of shorter WTGs. However, construction of a larger number of smaller-capacity turbines would still require similar measures to accommodate the proposed Project including coordination with military and national security entities and changes to air traffic navigational patterns.

Implementation of Alternatives B, C, D1, and E would not result in meaningfully different types or magnitudes of impacts on other uses compared to the Proposed Action. Therefore, the overall reported level of impact would remain similar to the Proposed Action, and the direct and indirect impacts resulting from individual IPFs associated with these alternatives on other uses would still be **negligible** to **minor** for aviation and air traffic, cables and pipelines, and radar systems; **minor** to **moderate** for military and national security uses; and **major** for scientific research and surveys.

The cumulative impacts of Alternatives B, C, D1, and E, when combined with past, present, and reasonably foreseeable activities, would be very similar to those of the Proposed Action, because the majority of the cumulative impacts come from other offshore wind projects, and the direct and indirect impacts of each alternative would be very similar to those of the Proposed Action. Cumulative impacts would be **negligible** to **minor** for aviation and air traffic, cables and pipelines, and radar systems; and **major** for military and national security uses and scientific research and surveys. This is driven primarily by the presence of offshore structures, primarily WTGs, in the RI and MA Lease Areas.

3.14.2.3. Cumulative Impacts of Alternative D2

The direct and indirect impacts of Alternative D2 on other uses are described in Draft EIS Section 3.4.8.6. These impacts, revised to reflect the use of 14-MW WTGs, are summarized below. Alternative D2 would implement the 1 x 1 nautical mile layout and arrange WTGs with east-west rows and north-south columns. Alternative D2 would align the Vineyard Wind 1 Project layout with layouts of other adjacent offshore wind facilities, and with the layout distance and orientation recommended in the USCG MARIPARS report (USCG 2020). The Alternative D2 layout would increase navigational safety by allowing USCG to set predictable SAR patterns and successfully complete more SAR missions, thus avoiding fatalities that might otherwise occur with other WTG layouts. As a result, the direct and indirect impacts of Alternative D2 on military and national security uses would have a range of impacts resulting from individual IPFs from **negligible** to **moderate**. Impacts from all other IPFs under Alternative D2 would remain the same as those of the Proposed Action.

The revised project design envelope with the larger (i.e., 14 MW) WTGs would be the maximum impact scenario for other uses, primarily due to WTG height. These changes to the design capacity would not alter the maximum potential impacts of Alternative D2 on other uses. In addition, increasing the size of the proposed substation would not change the analysis of impacts on other uses included in the Draft EIS, due to the small acreage affected and the onshore location.

The cumulative impacts of Alternative D2, when combined with past, present, and reasonably foreseeable activities, would be very similar to those of the Proposed Action, because the majority of the cumulative impacts come from other offshore wind projects, and the direct and indirect impacts of this each alternative would be very similar to those of the Proposed Action. Cumulative impacts would be **negligible** to **minor** for aviation and air traffic, cables and pipelines, and radar systems; **moderate** for military and national security uses; and **major** for scientific research and surveys. This is driven primarily by the presence of offshore structures, primarily WTGs, in the RI and MA Lease Areas.

3.14.2.4. Direct, Indirect, and Cumulative Impacts of Alternative F

Alternative F analyzes a new vessel transit lane through the WDA, in which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The WTGs that would have been located within the transit lane would not be eliminated from the Proposed Action; instead, the displaced WTGs would be shifted to locations south within the Lease Area. Under this alternative, BOEM is analyzing a 2- and 4-nautical-mile northwest/southeast vessel transit lane through the WDA combined with any action alternative; however, this analysis focuses on the combination of Alternative F with either the Proposed Action or Alternative D2 layout. Therefore, the number of turbines would remain the same. The northern transit lane within the WDA could result in the relocation of 16 to 34 WTG placements, an increased extent of inter-array cables, and a 12 to 61 percent increase in the size of the WDA, depending on whether the Proposed Action or Alternative D2 layout is used and how wide the transit lane is used.

Compared to the Proposed Action alone, establishment of an up to 4-nautical-mile-wide transit lane through the Proposed Action layout under Alternative F could reduce impacts from IPFs related to risk of collisions and allisions for vessels by providing an up to 4-nautical-mile area through the WDA that is cleared of surface obstructions and aligned with the northwest-southeast WTG layout. BOEM's assessment indicates that a wider, 4-nautical-mile transit lane could reduce impacts more than the 2-nautical-mile transit lane assessed by providing a wider area clear of structures. Some recreational fishing vessels could congregate at structures alongside the transit lanes, possibly increasing risks of collisions and allisions in these areas. The implementation of 4-nautical-mile transit lanes may allow for some ship-based scientific research and survey activity to occur within the transit lanes if conditions are appropriate considering the survey type to be conducted, vessel traffic, presence of submerged cables, or other operational restrictions. Four nautical mile transit lanes could also allow survey vessels to transit through the wind development areas, reducing the loss of travel efficiency when survey vessels are transiting between survey stations, dependent on sea conditions. In comparison and for assessment purposes, a 2-nautical-mile transit lane would not provide these benefits for scientific surveys. However, changes to scientific research and survey methodologies would still be similar to those required under the Proposed Action and the magnitude of impacts would remain the same. Alternative F may reduce overall impacts on open-ocean navigation and vessel traffic, but would not change the overall impact magnitudes described for the Proposed Action. Otherwise, the direct and indirect impacts from Alternative F in combination with the Proposed Action on other uses would still be **negligible** to **minor** for aviation and air traffic, cables and pipelines, and radar systems; **moderate** for military and national security uses; and **major** for scientific research and surveys.

Establishment of up to an 4-nautical-mile-wide transit lane through the Alternative D2 layout under Alternative F could result in increased impacts from IPFs related to allisions and collisions, including to military and national security vessels, but would reduce impacts on military and national security SAR activity. While, the presence of a transit lane could facilitate travel for vessels seeking to pass through the entire WDA the northwest-southeast transit lane orientation would differ from the east-west orientation of Vineyard Wind 1 WTGs. The differing orientations of the transit lane and WTG layout could increase navigational complexity for vessels operating within the area including military and national security vessels. Some commercial and recreational fishing and boating could occur within the transit lane, and recreational fishing vessels could congregate alongside the transit lanes, possibly increasing risks of collisions and allisions in these areas. This could lead to increased direct impacts on vessel traffic operating in the area including military and national security vessels; however, the magnitude of the impacts would remain the same as under the Proposed Action with either a 2- or a 4-nautical-mile-wide transit lane due to low military use of the WDA and the Department of Defense's evaluation that the Proposed Action in an older layout iteration (which did not provide transit lanes or a 1 x 1 nautical mile spacing) would have minor but acceptable impacts on military operations (F. Engel, Pers. Comm., 2018). The implementation of the 4-nautical-mile northern transit lane with Alternative D2 may allow for some ship-based scientific research and survey activity to occur within the transit lane if conditions are appropriate considering the survey type to be conducted, vessel traffic, presence of submerged cables, or other operational restrictions. A 4-nautical-mile transit lane could also allow survey vessels to transit through the wind development areas, reducing the loss of travel efficiency when survey vessels are transiting between survey stations, dependent on sea conditions. In comparison and for assessment purposes, a 2-nautical-mile transit lane would not provide these benefits for scientific surveys. However, changes to scientific research and survey methodologies would still be similar to those required under the Proposed Action and the magnitude of impacts would remain the same. Alternative F with a 2 to 4-nautical-mile transit lane in combination with Alternative D2 would also have direct and indirect **negligible** to **minor** impacts on aviation and air traffic, cables and pipelines, and radar systems; **moderate** impacts on military and national security uses; and **major** impacts on scientific research and surveys.

The direct and indirect impacts from the combination of the Alternative F with the Proposed Action or Alternative D2 is expected to be similar to combinations with the other action alternatives. Consequently, these other potential combinations are not separately analyzed here.

In considering the cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities, BOEM assumes for the purposes of this analysis that the transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. As in the Vineyard Wind lease area, the no surface occupancy requirement would prevent these adjoining leases from locating structures such as WTGs and ESPs, and temporary site assessment buoys or towers, within transit lanes. This could result in the loss of 36 WTG locations with a 2-nautical-mile lane or 75 locations with a 4-nautical-mile lane. As in the Vineyard Wind lease area, BOEM assumes that the WTGs that would have been located within the transit lane would be shifted to locations south within the Lease Area and not eliminated from construction. The impact level is driven primarily by the presence of offshore structures, primarily WTGs, in the RI and MA Lease Areas and the transit lane would not eliminate WTGs in this area but would displace them. Therefore, the overall cumulative impacts under Alternative F combined with the Proposed Action layout (as well as Alternative B, C, D1, and E) would remain similar to those described for the Proposed Action—**negligible** to **minor** for aviation and air traffic, cables and pipelines, and radar systems, and **major** for military and national security uses and scientific research and surveys. The overall cumulative impacts under Alternative F in combination with the Alternative D2 layout would remain similar to those described for the Alternative D2 alone—**negligible** to **minor** for aviation and air traffic, cables and pipelines, and radar systems; **moderate** for military and national security uses; and **major** for scientific research and surveys.

BOEM's analysis of Alternative F in this SEIS is focused on the implementation of RODA's northernmost transit lane through the WDA, and how that change to the Proposed Action would affect resources analyzed. The decision to implement RODA's six proposed transit lanes through the RI and MA Lease Areas is not the decision being evaluated in this SEIS; however, it is important to note that implementation of the additional five transit lanes through other lease areas would require no surface occupancy within those transit lanes, and other offshore wind project leaseholders could need to alter their site plans to relocate structures out of the transit lanes as well, specifically by locating WTGs further from shore, similar to the proposed Project. There are several items to further consider with the implementation of all six corridors: (1) Vineyard Wind and other Rhode Island and Massachusetts offshore wind leaseholders have committed to implementing a 1 x 1 nautical mile WTG grid layout in east-west orientation (equivalent to Alternative D2) in response to stakeholder feedback. The developers' agreement was reached to avoid irregular transit corridors. With the implementation of the six corridors implemented as part of RODA's suggestion, the agreement to this standard layout for offshore renewable energy could be jeopardized; (2) offshore wind developers would need to alter their site plans to accommodate the six transit corridors, potentially causing construction delays that could create more overlap with other future offshore wind projects' construction schedules, potentially leading to increased cumulative effects to resources sensitive to overlapping construction activities; (3) the addition of the 4-nautical-mile transit lanes proposed by RODA would reduce the technical capacity of the RI and MA Lease Areas by approximately 3,300 MW, which is 500 MW less than the current state demand for offshore wind in the area.[15]

Implementation of all RODA-recommended transit lanes across the RI and MA Lease Areas could potentially reduce cumulative impacts related to allision and collision risk throughout all lease areas. The January 3, 2020, proposal from RODA was to establish a series of six transit lanes through the overall RI and MA Lease Areas (only one of which would affect the WDA). The USCG's ongoing MARIPARS study is evaluating how transit corridors may affect allision risks. The draft study was published on January 29, 2020, and the USCG will make a final recommendation on transit routes after assessing the comments received during the Draft MARIPARS report comment period (USCG 2020). Some commercial and recreational fishing and boating could occur within the transit lanes, and recreational fishing vessels could congregate alongside the transit lanes, possibly increasing risks of collisions and allisions in these areas. Implementation of the 4-nautical-mile transit lanes may allow for some scientific research and survey activity to occur within the transit lane if conditions are appropriate considering the survey type to be conducted, vessel traffic, presence of submerged cables, or other operational restrictions. The 4-nautical-mile transit lanes could also allow survey vessels to transit through the wind development areas, reducing the loss of travel efficiency when survey vessels are transiting between survey stations, dependent on sea conditions. However, changes to scientific research and survey methodologies would still be required and the magnitude of impacts would remain the same.

3.14.2.5. Comparison of Alternatives

As discussed in Draft EIS Section 3.4.1.7, the Proposed Action and the action alternatives are similar in terms of the level of impact on other uses: aviation and air traffic, and radar systems—negligible to minor impacts; moderate impacts on military and national security uses; and major for scientific research and survey. Compared with the Proposed Action, Alternative B may slightly reduce exposure to risks associated with cabling due to the shorter cable route associated with Covell's Beach and avoidance of the National Grid Hyannis Port-Jettis Beach submarine cable. Alternative C may slightly increase impacts on military and national security vessel and air traffic by moving additional turbines into military warning area W-105A. Alternative C could also potentially decrease impacts air traffic and aviation by moving WTGs farther away from regional airports and associated obstacle clearance surfaces, and placing them where obstacle clearance surfaces are higher in elevation. Alternatives D1 and D2 may slightly decrease risks associated with vessel allisions, vessel-related navigation hazards, and space use conflicts on the water. Alternative D2 would reduce potential impacts on military and national security SAR activity (i.e., avoiding some fatalities that might occur under other alternatives). Alternative E may slightly decrease impacts compared to the revised Proposed Action for military operations and national security, aviation and air traffic, radar systems, and scientific research and surveys due to use of shorter but more numerous WTGs, but the overall magnitude of impacts would not change for any resource. Installing 57 to 84 WTGs under Alternative E would have slightly greater impacts than the revised Proposed Action due to an increased number of WTGs and an increase in the developed area within the WDA. Alternative F would have smaller direct and indirect impacts for IPFs related to allision risks due to reduced impacts associated with structures and vessel collision; however, implementation of the northern transit corridor associated with Alternative F could have cascading effects on adjacent offshore wind leases. These differences would result in incrementally different impacts (in timing and location of impacts), but would not change the overall magnitude of direct and indirect impacts described for the Proposed Action.

Cumulative impacts under any action alternative would likely be very similar because the majority of the cumulative impacts of any alternative come from future offshore wind development, which does not change between alternatives, and because the differences in direct and indirect impacts between action alternatives would not result in different direct and indirect impact magnitudes. As a result, cumulative impacts of any action alternative resulting from individual IPFs, when combined with past, present, and reasonably foreseeable actions, could result in negligible to moderate cumulative impacts for military and national security uses, aviation and air traffic, cables and pipelines, and radar systems, and major cumulative impacts for scientific research and surveys. The overall cumulative impacts of any action alternative when combined with past, present, and reasonably foreseeable activities pipelines would be negligible to minor for aviation and air traffic, cables and pipelines, and radar systems; and major for military and national security uses and scientific research and surveys (except for Alternative D2 and Alternative F combined with D2 which would result in moderate cumulative impacts military and national security uses). This is driven primarily by the presence of offshore structures, primarily WTGs, in the RI and MA Lease Areas.

[15] Approximately 775 WTGs are needed to meet existing state demand as considered in the cumulative scenario (57 14-MW WTGs from the Proposed Action, plus 717 12-MW WTGs for the remainder the proposed offshore wind projects in the RI and MA Lease Areas). Implementing RODA's six proposed transit lanes at a width of 2 nautical miles each would remove about 156 positions. Implementing RODA's six proposed 4-nautical-mile transit lanes would remove about 322 positions out of 1,059 possible foundation positions across the RI and MA Lease Areas due to surface occupancy restrictions, leaving about 737 positions available. Of those positions, approximately 14 positions would be occupied by ESPs, leaving 723 positions for WTGs, or 54 WTGs short of meeting the assumed demand. Total state demand for the RI and MA Lease Areas is assumed to be 9,404 MW, and technical capacity of the RI and MA Lease Areas is assumed to be 12,708 MW. The technical capacity of the remaining area after implementation of the transit lanes would be approximately 8,936 MW, leaving approximately 500 MW unfulfilled. Therefore, the total technical capacity loss in the RI and MA Lease Areas due to transit lanes proposed by RODA would be approximately 3,300 MW.

APPENDIX A

Cumulative Offshore Wind Activities Scenario and Assessment of Resources with Minor Impacts

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APPENDIX A. CUMULATIVE OFFSHORE WIND ACTIVITIES SCENARIO AND ASSESSMENT OF RESOURCES WITH MINOR IMPACTS

This appendix describes offshore wind development activities that the Bureau of Ocean Energy Management (BOEM) is considering reasonably foreseeable for the purpose of assessing cumulative impacts in this Supplemental Environmental Impact Statement (SEIS). In addition, to help comply with the page limits in the Department of the Interior's Secretarial Order 3355 and focus on the impacts of most concern in the main body of the SEIS, BOEM has included the analysis of resources with minor direct and indirect impacts in this Appendix (air quality, water quality, birds, and bats). Those resources with potential impact ratings greater than minor are included in SEIS Chapter 3.

Cumulative impacts are the incremental effects of the Proposed Action on the environment when added to other past, present, or reasonably foreseeable actions taking place within the region of the proposed Project, regardless of which agency or person undertakes the actions (40 Code of Federal Regulations [CFR] 1508.7). This SEIS discusses resource-specific cumulative impacts that could occur if direct and indirect impacts associated with the Proposed Action would contribute to or overlap spatially or temporally with impacts from other past, present, or reasonably foreseeable actions associated with offshore wind projects along the east coast of the United States. This appendix focuses on the cumulative scenario associated with reasonably foreseeable offshore wind development activities described in Chapter 1. Unless otherwise specified in this SEIS, BOEM considers information related to past, present, and other future projects, including non-offshore wind-related activities, the same as presented in the Draft EIS.

As described in SEIS Section 1.2, BOEM conducted a thorough process to identify the possible extent of reasonably foreseeable offshore wind development on the Atlantic Outer Continental Shelf (OCS). As a result of this process, BOEM has assumed that approximately 22 gigawatts (GW) of Atlantic offshore wind development are reasonably foreseeable along the east coast. Reasonably foreseeable development includes 17 active wind energy lease areas (16 commercial and 1 research) (Figure A.1-1), which include named projects and assumed future development within the remainder of lease areas outside of named project boundaries, as described in this appendix and in SEIS Section 1.2. Levels of assumed future development are based on state commitments to renewable energy development, available turbine technology, and the size of potential development areas. These assumptions form the basis for analyzing potential resource-specific cumulative impacts (SEIS Chapter 3).

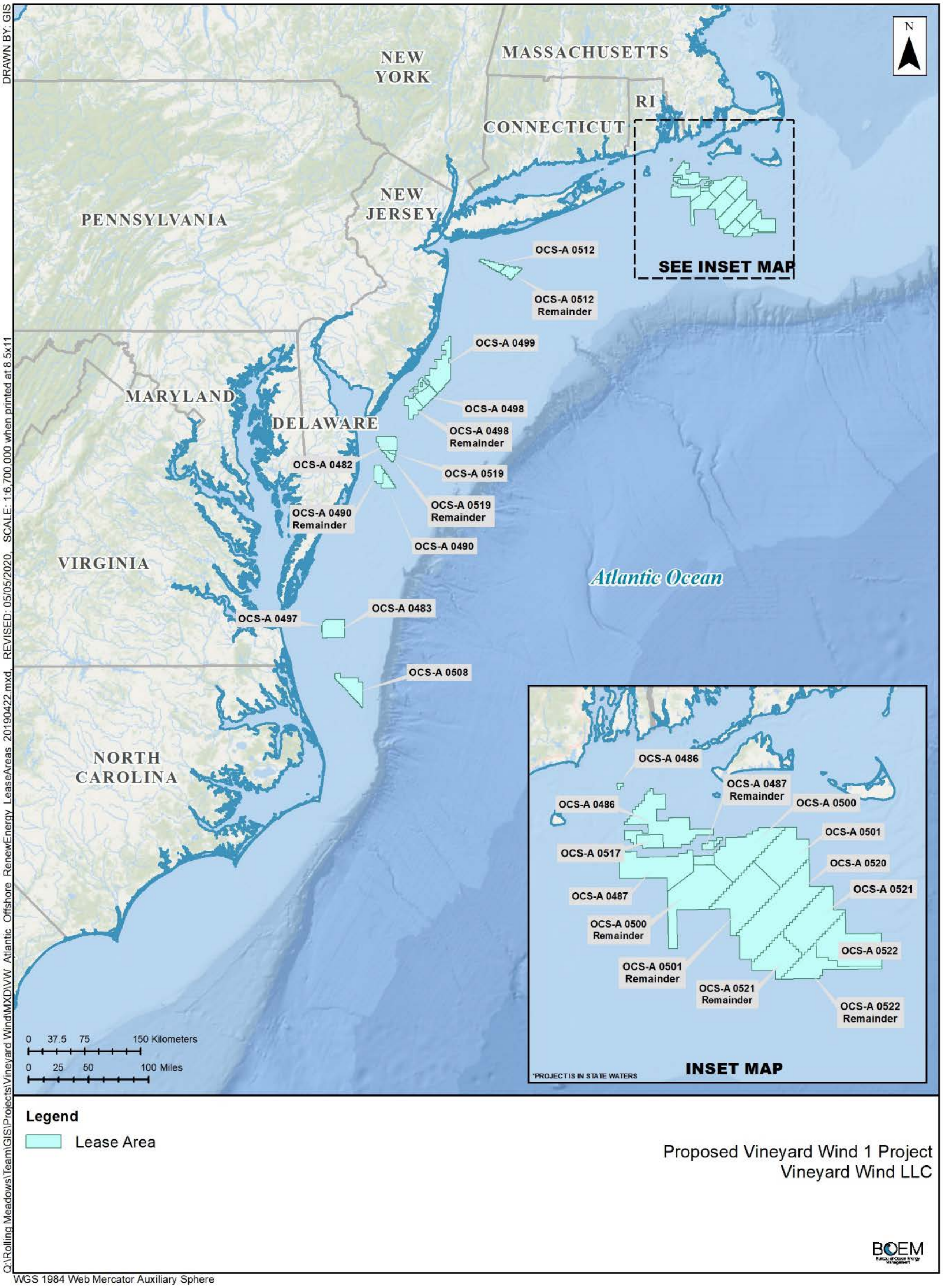

Figure A.1-1: Wind Lease Areas Considered in Cumulative Offshore Wind Activities Scenario

Under the renewable energy regulations, the issuance of leases and subsequent approval of wind energy development on the OCS is a phased decision making process and occurs over several years. Starting with lease issuance, the process follows these general steps:

- Lease Issuance—BOEM issues a commercial wind energy lease that gives the lessee exclusive rights to seek BOEM approval for the development of the lease area. BOEM conducted National Environmental Policy Act (NEPA) analyses and assessed the potential impacts of site characterization surveys for offshore Rhode Island, Massachusetts, New York, and the Mid-Atlantic (76 Federal Register [Fed. Reg.] 169 [August 18, 2011], BOEM 2016b, and BOEM 2015a respectively). Lessees may request to assign a portion of their lease to another qualified legal entity which would lead to a new lease number within a previously defined lease area. A new lease would not impact the cumulative scenario because the cumulative acreage of lease area available for development would remain unchanged.
- Site Assessment Plan (SAP) Review/Approval[1]—Although a SAP is not required, BOEM assumes that every lessee will plan to install one meteorological tower or one to two meteorological buoys for site assessment. If the lessee is proposing to install site assessment facilities, the lessee has 1 year after lease execution to submit a SAP, which must contain a detailed proposal for the installation and, if applicable, construction of meteorological towers or buoys. BOEM must approve the SAP before site assessment activities commence. After SAP approval, the lessee has up to 5 years to complete site characterization and site assessment activities to support a Construction and Operations Plan (COP). BOEM conducted NEPA analyses and assessed the potential impacts of site assessment activities for offshore Rhode Island, Massachusetts, New York, and the Mid-Atlantic (76 Fed. Reg. 169 [August 18, 2011], BOEM 2016b, and BOEM 2015a respectively).
- COP Review and Approval—Six months prior to the end of the 5-year assessment term, the lessee submits a COP that contains a detailed plan for the construction and operation of a wind energy project on the lease area. COP submittal triggers a project-specific NEPA analysis (for Vineyard Wind, this current NEPA process). After completion of the NEPA document, BOEM may approve, approve with modifications, or disapprove a lessee's COP. If approved, the lessee is allowed to construct and operate wind turbine generators and associated facilities for the operations term of the lease (typically 25 years) (BOEM 2016b).[2]

The following sections describe reasonably foreseeable activities associated with offshore wind development on the Atlantic OCS and identify the development status of proposed offshore wind projects. Reasonably foreseeable activities associated with offshore wind development include site characterization studies, site assessment activities, construction and operation of offshore wind facilities, port upgrades, and construction and maintenance of offshore export cables. These sections also identify assumptions used to evaluate potential impacts in the geographic analysis areas identified for resource-specific cumulative analysis contained within this SEIS.

A.1. Resource Geographic Analysis Areas

Each resource has a geographic distribution and these differ in the areas that may be affected by the proposed Project (Table A-1). Figures A.7-1 through A.7-16 identify the resource-specific geographic analysis areas. Table A-4 lists reasonably foreseeable wind energy projects or activities in addition to the proposed Project. The table identifies whether these projects or activities are located within particular resource-specific analysis areas and thus are considered in the SEIS cumulative impacts analysis. BOEM has adjusted the geographic analysis areas for impacts for six resources since the Draft EIS: Air Quality, Water Quality, Birds, Bats, Navigation, and Economics. The reasons for these changes are described below.

Table A-1: Resource-Specific Geographic Analysis Areas for Cumulative Analysis

Resource	Geographic Analysis Area
Terrestrial And Coastal Fauna	The geographic analysis area for terrestrial and coastal fauna is defined by a 0.5-mile (0.8-kilometer) buffer around all land areas that would be disturbed by the proposed Project. As described in Draft EIS Section 3.3.1, BOEM expects the terrestrial and coastal fauna in this area to have small home ranges. These resources are unlikely to be affected by impacts outside their home ranges. Figure A.7-1 depicts the geographic analysis area for terrestrial and coastal fauna. The geographic analysis area is identical to that considered in the Draft EIS. This discussion of terrestrial and coastal fauna does not include birds, which are discussed separately under Section A.8.3, or bats, which are discussed separately under Section A.8.4.
Coastal Habitats	The geographic analysis area for coastal habitats is defined as all lands and waters within the 3-nautical-mile seaward limit of Massachusetts' territorial sea to 100 feet (30.5 meters) landward of the first major land transportation route encountered (a road, highway, rail line, etc.) that is within a 1-mile (1.6-kilometer) buffer of the OECC. Figure A.7-2 depicts the geographic analysis area for coastal habitats. Although the plants and animals that build biogenic coastal habitats do not move appreciably except through reproduction, this buffer allows for the gradual progression of these organisms across the seascape. The geographic analysis area is identical to that considered in the Draft EIS.

[1] Note that BOEM may approve, approve with modifications, or disapprove a lessee's Site Assessment Plan.
[2] For analysis purposes, BOEM assumes in this SEIS that the proposed Project would have an operating period of 30 years. Vineyard Wind's lease with BOEM (Lease OCS-A 0501) has an operations period of 25 years that commences on the date of COP approval (https://www.boem.gov/Lease-OCS-A-0501/ at Addendum B; 30 CFR § 585.235(a)(3)). Vineyard Wind would need to request an extension of its operations period from BOEM in order to operate the proposed Project for 30 years. For purposes of the maximum-case scenario and to ensure NEPA coverage if BOEM grants such an extension, however, the SEIS analyzes a 30-year operations period.

Resource	Geographic Analysis Area
Benthic Resources	The geographic analysis area for benthic resources extends for a 10-mile (16.1-kilometer) radius around the WDA and the OECC proposed in the COP. This area is based upon where the most widespread impact (namely, suspended sediment) from the proposed Project could affect benthic resources. While sediment transport beyond this radius is possible, sediment transport related to the proposed activities is likely to remain within this area, according to the results of the model presented in COP Appendix III-A (Epsilon 2018a). Highly mobile benthic animals and planktonic life stages of otherwise benthic organisms may be affected by activities outside of this area and are therefore considered among the resources discussed in Section 3.3. The following analysis includes any reasonably foreseeable offshore wind developments in lease areas with a more-than-nominal overlap with the geographic analysis area. Figure A.7-3 depicts the geographic analysis area. The geographic analysis area is identical to that considered in the Draft EIS.
Finfish, Invertebrates, and Essential Fish Habitat (EFH)	The geographic analysis area for finfish, invertebrates, and EFH is the U.S. waters of the LME, which is likely to capture the majority of the movement range for most species in this group. The Northeast Shelf LME extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina. Figure A.7-4 depicts the geographic analysis area for finfish, invertebrates, and EFH. The geographic analysis area for finfish, invertebrates, and EFH is similar to that considered in the Draft EIS, but its northern portion has been slightly reduced to include only U.S. waters.
Marine Mammals	The geographic analysis area for marine mammals includes the Scotian Shelf, Northeast Shelf, and Southeast Shelf LMEs, which are likely to capture the majority of the movement range for most species in this group. 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. The Northeast Shelf LME extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina. The Southeast Shelf LME extends from the Straits of Florida to Cape Hatteras, North Carolina. These LMEs extend from the coastline offshore to the shelf break (at approximately 328.1 to 656.2 feet [100 to 200 meters] depth). The geographic analysis area is identical to that considered in the Draft EIS. Figure A.7-5 depicts the geographic analysis area for marine mammals.
Sea Turtles	The geographic analysis area for sea turtles includes the Scotian Shelf, Northeast Shelf and Southeast Shelf LMEs, which are likely to capture the majority of the movement range within U.S. waters for most species in this group. LMEs are delineated based on ecological criteria including bathymetry, hydrography, productivity, and trophic relationships among populations of marine species, and NOAA uses them as the basis for ecosystem-based management. The Northeast Shelf LME extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina. The Southeast Shelf LME extends from the Straits of Florida to Cape Hatteras, North Carolina. These LMEs extend from the coastline offshore to the shelf break (at a depth of approximately 328.1 to 656.2 feet [100 to 200 meters]). The geographic analysis area of nesting for all turtle species ranges from North Carolina southward. The geographic analysis area is identical to that considered in the Draft EIS. Figure A.7-6 depicts the geographic analysis area for sea turtles.
Demographics, Employment, and Economic Characteristics	The geographic analysis area for demographics, employment, and economic characteristics includes the counties where proposed onshore infrastructure and potential port cities are located, as well as the counties in closest proximity to the WDA (Barnstable, Bristol, Dukes, and Nantucket counties, Massachusetts; and Providence and Washington counties, Rhode Island). Figure A.7-7 depicts the geographic analysis area for demographics, employment, and economic characteristics. These counties are the most likely to experience beneficial or adverse economic impacts from the proposed Project. The geographic analysis area is smaller than the geographic analysis area considered in the Draft EIS. The Draft EIS included Fairfield and New London counties, Connecticut. These counties have been removed from the geographic analysis area because the Port of Bridgeport in Fairfield County and the Port of New London/Groton in New London County are no longer being considered as supporting facilities for the Vineyard Wind 1 Project offshore construction.
Environmental Justice	The geographic analysis area for environmental justice populations includes the counties where proposed onshore infrastructure and potential port cities are located, as well as counties in closest proximity to the WDA (Barnstable, Bristol, Dukes, and Nantucket counties, Massachusetts; and Providence and Washington counties, Rhode Island). Figure A.7-7 depicts the geographic analysis area for environmental justice populations. These counties, and environmental justice communities located within them, are the most likely to experience economic impacts from the Proposed Action. The geographic analysis area for environmental justice populations is smaller than the geographic analysis area considered in the Draft EIS. The Draft EIS included Fairfield and New London counties, Connecticut. These counties have been removed from the geographic analysis area, because the Port of Bridgeport in Fairfield County and the Port of New London/Groton in New London County are no longer being considered for use supporting facilities for the Vineyard Wind 1 Project offshore construction.
Cultural Resources	The geographic analysis area for cultural resources consists of the direct and indirect areas of potential effect, as well as the locations of known or planned future offshore wind development off the coast of Cape Cod, Nantucket, and Martha's Vineyard. Figure A.7-8 depicts the geographic analysis area for cultural resources. For visually affected cultural resources, the geographic analysis area is limited to the viewshed area of intervisibility for the Proposed Action and the future offshore projects within the geographic analysis area for cultural resources. For all other cultural resources, the geographic analysis area is limited to the Proposed Action's terrestrial land and seafloor disturbance. As a result, the geographic analysis area for cultural resources is defined as follows: • The depth and breadth of the seabed potentially affected by any bottom-disturbing activities associated with the construction, including but not limited to the WTGs, offshore export cables, and support facilities, as well as areas that could be impacted by associated activities such as dredging, deploying and moving vessel anchors, and temporary or permanent construction or staging areas; • The depth and breadth of terrestrial areas potentially affected by ground-disturbing activities associated with construction of onshore infrastructure such as export cables, transmission lines, electrical substations, port expansions, and temporary or permanent construction or staging areas; and

Resource	Geographic Analysis Area
	• The area of intervisibility between the viewshed from which structures from the Proposed Action would be visible and the viewshed from which structures would be visible from reasonably foreseeable offshore wind developments. The analysis of cumulative visual impacts is applied only to those historic properties that are adversely affected by the Proposed Action and that have a view of other reasonably foreseeable offshore wind developments. Although the description of the geographic analysis area has changed since the Draft EIS, the analysis area shown on Figure A.7-8 has not changed.
Recreation And Tourism	The geographic analysis area for recreation and tourism is the proposed RI and MA Lease Area plus a 35.3-mile (56.8-kilometer) visual analysis area measured from the borders of the proposed Project WDA, as shown on Figure A.7-9. This radius is the area from which any portion of the proposed Project facilities would potentially be visible (based on a maximum rotor tip height of 837 feet [255 meters] above mean sea level, when considering only the obscuring effect of the curvature of the earth's surface). The geographic analysis area is the same as the area considered in the Draft EIS and includes marine areas, coastlines, and onshore areas where multiple projects could be visible simultaneously. The geographic analysis area includes many marinas and harbors on Martha's Vineyard, Nantucket, and Cape Cod that are important for recreational and sightseeing vessels. However, many of the recreational vessels that travel within and through the a geographic analysis area originate outside the geographic analysis area, including some that travel from Massachusetts and Rhode Island ports that would be used to support offshore wind development. The impacts of offshore wind development on ports are captured in other sections and is mentioned but not addressed in detail in this section.
Commercial Fisheries and For-Hire Recreational Fisheries	The geographic analysis area for commercial fisheries and for-hire recreational fishing is the boundaries of the management area of the New England Fishery Management Council and of the Mid-Atlantic Fishery Management Council for all federal fisheries within the U.S. Exclusive Economic Zone (from 3 to 200 nautical miles from the coastline) through Cape Hatteras, North Carolina, plus the state waters of the Commonwealth of Massachusetts (from 0 to 3 nautical miles from the coastline). For an analysis of private recreational fishing, see Section 3.10. Figure A.7-10 depicts the geographic analysis area for commercial fisheries and for-hire recreational fishing. The geographic analysis area is different from that considered in the Draft EIS, and now extends southward to Cape Hatteras, North Carolina, to include all reasonably foreseeable projects. The new geographic analysis area is the extent of fishing activities that overlap with the Vineyard Wind WDA and all reasonably foreseeable lease areas assigned to potential future power procurements in New England and the Mid-Atlantic.
Land Use and Coastal Infrastructure	The geographic analysis area for land use and coastal infrastructure includes the towns of Barnstable and Yarmouth, and ports potentially used for the proposed Project's construction and installation, operations and maintenance, and decommissioning. These areas encompass locations where BOEM anticipates direct and indirect impacts associated with proposed onshore facilities and ports. Figure A.7-11 depicts the geographic analysis area for land use and coastal infrastructure. The geographic analysis area is smaller than the geographic analysis area considered in the Draft EIS. The Draft EIS included the ports of Bridgeport and New London/Groton in Connecticut; however, these are no longer being considered as supporting facilities for the Vineyard Wind 1 Project offshore construction.
Navigation and Vessel Traffic	The geographic analysis area for navigation and vessel traffic extends for a 10-mile (16.1-kilometer) radius around the WDA, the OECC, and vessel approach routes to the ports of New Bedford, Montauk, and Brayton Point in Bristol County, Massachusetts, ProvPort in Providence County, Rhode Island, and the Port of Davisville (Quonset Point) in Washington County, Rhode Island. Figure A.7-12 depicts the geographic analysis area for navigation and vessel traffic. These ports have been identified as suitable to support the offshore wind industry in Massachusetts and Rhode Island. The geographic analysis area has been modified since the Draft EIS. The Draft EIS included the ports of Bridgeport and the New London/Groton in Connecticut, which are no longer being considered for use as supporting facilities for Vineyard Wind 1 Project offshore construction. In addition, the geographic analysis area has been expanded to include all RI and MA Lease Areas for this cumulative analysis scenario due to presence of structures.
Other Uses	The geographic analysis area for marine minerals, military and national security uses, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys is described below and shown on Figure A.7-13. Draft EIS Section 3.4.8 analyzes potential effects of the Proposed Action on marine minerals extraction. BOEM is not analyzing the impacts of future offshore wind energy on marine minerals extraction because the Proposed Action would have no impacts on marine minerals extraction, and could not contribute to cumulative impacts on marine minerals extraction. In addition, BOEM assumes that export cables associated with future offshore wind projects—including Vineyard Wind 2, Mayflower Wind, South Fork Wind, and other potential projects within the RI and MA Lease Areas—would avoid identified borrow areas because BOEM would consult with the BOEM Marine Minerals Program and USACE before approving offshore wind cable routes, avoiding impacts on known borrow areas. • Military and National Security Uses: The geographic analysis area includes airspace, surface, and submarine areas that are utilized by regional military entities in an area roughly bounded by Montauk, New York; Providence, Rhode Island; Provincetown, Massachusetts; and within a 10-mile (16-kilometer) buffer from the RI and MA Lease Areas. The geographic analysis area is the same as the geographic analysis area considered in the Draft EIS. • Aviation and Air Traffic: The geographic analysis area includes airspace and airports used by regional air traffic, generally an area roughly bounded by Montauk, New York; Providence, Rhode Island; Provincetown, Massachusetts; and within a 10-mile (16-kilometer) buffer from wind lease areas in the RI and MA Lease Areas. The geographic analysis area is the same as the geographic analysis area considered in the Draft EIS. • Offshore Energy: Draft EIS Section 3.4.8 analyzes potential impacts of the Proposed Action on other offshore energy projects. The geographic analysis area includes the seven active offshore RI and MA Lease Areas that

Resource	Geographic Analysis Area
	are not yet developed. No other reasonably foreseeable energy projects were identified in the geographic study area. BOEM is not analyzing the impacts of future offshore wind energy on offshore energy but is analyzing the impact of the Proposed Project on offshore energy. Therefore, the analysis of these impacts is limited to sections on Proposed Action and Action Alternatives. • Cables and Pipelines: The geographic analysis area includes areas within 1 mile (1.6 kilometers) of the OECC and WDA and the RI and MA Lease Areas that could affect future siting or operation of cables and pipelines. The geographic analysis area is the same as the geographic analysis area considered in the Draft EIS. • Radar Systems: The geographic analysis area is the same as that identified for aviation and air traffic, and includes airspace and airports used by regional air traffic, generally an area roughly bounded by Montauk, New York; Providence, Rhode Island; Provincetown, Massachusetts; and within a 10-mile (16-kilometer) buffer from wind lease areas in the RI and MA Lease Areas. The geographic analysis area is the same as the geographic analysis area considered in the Draft EIS. • Scientific Research and Surveys: The geographic analysis area is the same as for Finfish, invertebrates, and EFH (Table A-1) and includes the footprint of the Proposed Action and all reasonably foreseeable projects (as outlined in Figure A.7-4) between Maine and mid-North Carolina. The geographic analysis area is reduced from what was considered in the Draft EIS—which also included areas southwards to Florida—to better reflect the locations of scientific research and surveys similar to what is expected to occur within the WDA and OECC route.
Air Quality	The geographic analysis area for air quality includes the airshed within 15.5 miles (25 kilometers) of each area potentially impacted by the proposed Project, including the lease area, the on-land construction areas, and the mustering port(s). Given the generally low emissions of the sea vessels and equipment that would be used during proposed construction activities, any potential air quality impacts would likely be within a few miles of the source. BOEM selected the 15.5 mile (25 kilometer) distance to provide a reasonable buffer. Ozone is an exception. It is a significant regional pollutant, and this SEIS includes a detailed review of potential Project and cumulative impacts on regional ozone development. Figure A.7-14 depicts the geographic analysis area for air quality. Although the description of the geographic analysis area for air quality has not changed since the Draft EIS, the area itself has changed from that described in the Draft EIS due to removal of ports in Connecticut.
Water Quality	The offshore geographic analysis area for water quality extends for a 10-mile (16.1-kilometer) radius around the WDA, the OECC, and vessel approach routes to port facilities that would be used by the proposed Project. This area accounts for some transport of water masses due to ocean currents. Onshore, the water quality geographic analysis area includes the proposed Project footprint and surrounding areas. Figure A.7-15 depicts the geographic analysis area for water quality. The description of the geographic analysis area for water quality has been updated since the Draft EIS to include onshore components of the proposed Project. In addition, the offshore geographic area considered in this analysis is slightly reduced from the geographic analysis area considered in the Draft EIS because the Ports of Bridgeport and New London/Groton in Connecticut are no longer being considered for use as supporting facilities for the proposed Project.
Birds	The geographic analysis area for birds includes the U.S. East Coast from Maine to Florida to cover migratory species that may encounter the proposed Project and that utilize habitats along these states. The offshore limit is 100 miles (161 kilometers) from the Atlantic shore to capture the migratory movements of most species in this group. The onshore limit is 0.5 mile (0.8 kilometer) inland to cover onshore habitats used by the species that may be affected by offshore components of the proposed Project as well as those species that could be affected by proposed onshore Project components. While the geographic extent of the cumulative impact scenario provided in Draft EIS Appendix C extended 100 miles (161 kilometers) inland, the buffer was reduced in this analysis because the species that would be exposed to offshore and onshore components of the proposed Project are not expected to utilize habitats farther than 0.5 mile (0.8 kilometer) inland. Figure A.7-16 depicts the geographic analysis area for birds.
Bats	While some historic, anecdotal observations of bats up to 1,212 miles (1950 kilometers) offshore of North America exist, recent offshore observations of tree bats range from 10.5 to 26 miles (16.9 to 41.9 kilometers; Hatch et al. 2013). As such, the geographic analysis area for bats includes the U.S. East Coast, from Maine to Florida, to capture migratory species, and extends 100 miles (161 kilometers) offshore and 5 miles (8 kilometers) inland to capture the migratory movements of most species in this group. Northern long-eared bats (*Myotis septentrionalis*) and other cave bats do not typically occur on the OCS. Tree bats are long-distance migrants whose ranges include the majority of the Atlantic coast from Florida to Maine. While these species have been documented traversing the open ocean and have the potential to encounter WTGs, use of offshore habitat is thought to be limited and generally restricted to spring and fall migration. The onshore limit of the geographic scope is intended to cover a majority of the onshore habitat use by those species that may encounter the proposed Project during the majority of their life cycle. While the inland extent of the cumulative impact scenario provided in Draft EIS Appendix C extended 100 miles (161 kilometers), the buffer was reduced to 5 miles (8 kilometers) in this analysis because the individuals that would potentially be exposed to the proposed Project during migration would not be expected to utilize habitats far inland, and projects that occur far inland are not expected to affect the same individuals as the proposed Project. Figure A.7-16 depicts the geographic analysis area for bats.

BOEM = Bureau of Ocean Energy Management; COP = Construction and Operations Plan; EFH = Essential Fish Habitat; EIS = Environmental Impact Statement; LME = Large Marine Ecosystem; NEPA = National Environmental Policy Act; NOAA = National Oceanic and Atmospheric Administration; OECC = Offshore Export Cable Corridor(s); RI and MA Lease Areas = Rhode Island and Massachusetts Lease Areas; USACE = U.S. Army Corps of Engineers; WDA = Wind Development Area; WTG = wind turbine generator

A.2. Site Characterization Studies

A lessee is required to provide the results of site characterization activities (shallow hazard, geological, geotechnical, biological, and archaeological surveys) with its SAP or COP. A reasonably foreseeable consequence of issuing these leases is site characterization and site assessment (discussed in Section A.3). For the purposes of the cumulative impacts analysis, BOEM assumes site characterization surveys will occur on all existing leases during the life of a proposed project. BOEM makes the following assumptions for survey and sampling activities:

- Site characterization would likely take place in the first 3 years following execution of lease, based on the fact that a lessee would likely want to generate data for its COP at the earliest possible opportunity. Site assessment would likely take place starting within 1 to 2 years of lease execution, as preparation of a SAP (and subsequent BOEM review) takes time.
- Lessees would likely survey most or all of the proposed lease area during the 5-year site assessment term to collect required geophysical information for siting of a meteorological tower and/or two buoys and commercial facilities (wind turbines). The surveys may be completed in phases, with the meteorological tower and/or buoy areas likely to be surveyed first.
- Lessee would not use air guns, which are typically used for deep penetration two-dimensional or three-dimensional exploratory seismic surveys to determine the location, extent, and properties of oil and gas resources (BOEM 2016b).

Table A-2 describes the typical site characterization surveys, the types of equipment and/or method used, and which resources the survey information would inform.

Table A-2: Site Characterization Survey Assumptions

Survey Type	Survey Equipment and/or Method	Resource Surveyed or Information Used to Inform
High-resolution geophysical surveys	Side-scan sonar, sub-bottom profiler, magnetometer, multi-beam echosounder	Shallow hazards,[a] archaeological,[b] Bathymetric charting, benthic habitat
Geotechnical/ sub-bottom sampling [c]	Vibracores, deep borings, cone penetration tests	Geological [d]
Biological [e]	Grab sampling, benthic sled, underwater imagery/ sediment profile imaging	Benthic habitat
	Aerial digital imaging; visual observation from boat or airplane	Avian
	Ultrasonic detectors installed on survey vessels used for other surveys	Bat
	Visual observation from boat or airplane	Marine fauna (marine mammals and sea turtles)
	Direct sampling of fish and invertebrates	Fish

Source: BOEM 2016b

[a] 30 CFR § 585.610(b) and 30 CFR § 585.626(a)(1)
[b] 30 CFR § 585.610–585.611 and 30 CFR § 585.626(a)
[c] 30 CFR § 585.610(b)(1) and 30 CFR § 585.626(a)(4)
[d] 30 CFR § 585.610(b)(4) and 30 CFR § 585.626(a)(2)
[e] 30 CFR § 585.610(b)(5), 30 CFR § 585.611(b)(3-5), 30 CFR § 585.626(a)(3), and 30 CFR § 585.627(a)(3-5)

The following sections provide specific details by reference of these types of surveys as provided in the *Revised Environmental Assessment for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York* (BOEM 2016b), as well as an overview of survey techniques such that potential impacts may be evaluated.

A.3. SITE ASSESSMENT ACTIVITIES

After SAP approval, a lessee can evaluate the meteorological conditions, such as wind resources, with the approved installation of meteorological towers, buoys, or moorings. For those lessees with submitted SAPs (Table A-3), site assessment activities are also considered in this cumulative analysis.

Table A-3: Cumulative Impacts Projects: Site Assessment Activities

Lease Number	State	Company Name	Initial Date SAP Received	Date SAP Approved	Date Deployed or to be Deployed	Facility Description
OCS-A 0482	Delaware	Garden State Offshore Energy I, LLC (Deepwater Wind & PSEG)	7/2018	12/6/2019	Deployed, 1/20/2020	One met buoy
OCS-A 0483	Virginia	Dominion Energy Services, Inc.	5/2014	10/12/2017	Q2 2020	One met buoy
OCS-A 0486	Rhode Island and Massachusetts	Deepwater Wind New England, LLC	4/1/2016	10/12/2017	1/17/2019	One met buoy
OCS-A 0490	Maryland	US Wind, Inc.	11/2015	3/22/2018	TBD	One met tower, seabed mountain sensors
OCS-A 0497	Virginia	Virginia Department of Mines, Minerals and Energy/Dominion Energy Services, Inc.	12/2014 [a]	6/20/2019 [a]	March–October 2020	One wave/current buoy
OCS-A 0498	New Jersey	OceanWind LLC	9/15/2017	5/16/2018	8/20/2018	Two met buoys, one met/current buoy
OCS-A 0499	New Jersey	EDF Renewables Development, Inc.	12/9/2019	TBD	TBD	Two met buoys
OCS-A 0500	Massachusetts	Bay State Wind	12/20/2016	6/29/2017	7/10/2017	Two met buoys
OCS-A 0501	Massachusetts	Vineyard Wind LLC	3/31/2017	5/10/2018	5/22/2018	Two met buoys
OCS-A 0508	North Carolina	Avangrid Renewables, LLC	9/18/2019	TBD	TBD	Up to two buoys and up to two platforms
OCS-A 0512	New York	Equinor (Statoil), LLC	6/18/2018	11/21/2018	TBD	Two met buoys, one wave/met buoy, and one subsea Current Meter Mooring
OCS-A 0521	Massachusetts	Mayflower Wind	7/29/2019	TBD	TBD	One met buoy
OCS-A 0522	Massachusetts	Vineyard Wind LLC	3/6/2020	TBD	TBD	Two met buoys

met = meteorological; NA = not applicable; SAP = Site Assessment Plan; TBD = to be determined
[a] Included in modifications to Research Activities Plan rather than SAP

A.4. Construction and Operation of Offshore Wind Facilities

For purposes of this cumulative analysis, BOEM is classifying 22 GW of potential future offshore wind construction within the Atlantic OCS as reasonably foreseeable. The 22 GW of constructed capacity would include a combination of development within the 17 active wind energy lease areas (16 commercial and 1 research) (Figure A.1-1), which include named projects and assumed future development within the remainder of lease areas outside of named project boundaries. A detailed description of proposed activities associated with each named project and remnant lease areas is provided in Table A-4. Figures A.7-1 through A.7-16 show the geographic analysis area for each resource evaluated in this SEIS. The specific locations of wind turbine generators (WTGs), electrical service platforms (ESPs), offshore export cable routes, the principal ports to be used during construction, and the principal ports to be used during operations and maintenance are unknown for projects in the early stage of development. Some similar information is also unknown for areas of offshore wind development required to meet the energy demands described in Chapter 1 within existing lease areas but outside of specifically named project boundaries. Therefore, when predicting the potential impacts of possible future offshore wind activities, BOEM has made assumptions to determine whether and how much the future offshore wind activities could overlap each geographic analysis area, which are described below and listed in Table A-4.

BOEM assumes that all offshore wind developments offshore Massachusetts and Rhode Island would have 1 x 1 nautical mile spacing. This assumption was made based on the 2019 agreement made among developers and does not preclude the selection of another alternative by the decision maker (Figure A.7-17). The U.S. Coast Guard's (USCG's) Draft Massachusetts and Rhode Island Port Access Route Study (MARIPARS), evaluating the need for establishing vessel routing measures, was published on January 29, 2020 (85 Fed. Reg. 5222). The Draft MARIPARS report recommended an aligned, regular, and gridded layout throughout the Rhode Island and Massachusetts Lease Areas (RI and MA Lease Areas) that provides adequate sea room to facilitate predictable safe navigation throughout the contiguous leases. The recommendation includes three "lines of orientation," or predictable headings that vessels can take at any location within the contiguous lease areas. The Draft MARIPARS report stated that 1-nautical-mile wide east-to-west paths would facilitate traditional fishing methods in the area, 1 nautical mile wide north-to-south paths would provide the USCG with adequate access for search and rescue access. Finally, 0.6- to 0.8-nautical-mile wide northwest-to-southeast paths would allow commercial fishing vessels to continue their travel from port, through the lease areas, and to fishing grounds. The five Rhode Island and Massachusetts offshore wind leaseholders have proposed a collaborative regional layout for wind turbines (1 x 1 nautical mile apart in fixed east-to-west rows and north-to-south columns, with 0.7-nautical-mile theoretical transit lanes oriented northwest-southeast) across their respective BOEM leases (Geijerstam et al. 2019), which meets the layout rules set forth in the Draft MARIPARS report recommendations. Though the USCG attached to the MARIPARS Federal Register Docket the Responsible Offshore Development Alliance's (RODA) proposal (Hawkins and Johnston 2020) recommending additional transit corridors through the lease areas, the Draft MARIPARS concluded that if the layout in the recommendations were implemented, the USCG would not pursue any additional routing measures. As cooperating agencies, BOEM and USCG will continue to consult over the course of the NEPA process for the proposed Project as it relates to navigational safety and other aspects. The USCG will make a final recommendation on transit routes after the comments received during the Draft MARIPARS report comment period are assessed. Wind development offshore other states is assumed to occur at the same density as 1 x 1 nautical mile spacing, but no particular layout orientation or foundation spacing is assumed as ocean users offshore different states may have different patterns of movement or considerations than projects in leases offshore Massachusetts and Rhode Island. A new alternative, Alternative F, has been incorporated into this SEIS to assess potential individual and cumulative impacts of the RODA proposal.

The anticipated construction schedule of when projects in the different regions would foreseeably start construction is presented in Table A-6.

In addition to the assumptions identified under Table A-4, future offshore wind projects would be subject to evolving economic, environmental, and regulatory conditions. Lease areas may be split into multiple projects, expanded, or removed, and development within a particular lease area may occur in phases over long periods of time. Research currently being conducted[3] in combination with data gathered regarding physical, biological, socioeconomic, and cultural resources during development of initial offshore wind projects in the United States could affect the design and implementation of future projects, as could advancements in technology. For these reasons, it is not possible to accurately predict the nature, location, and scale of potential impacts on resources across all lease areas. At the time of this SEIS, 21 percent of the OCS Atlantic lease areas (1,744,289 acres [705,891 hectares] have submitted a COP to BOEM for review and consideration which is comprised of only seven locations out of the seventeen. BOEM has made the following qualitative assumptions about possible future impacts of offshore wind development across all leased areas that have been considered in the cumulative impact analysis for this SEIS, including:

- BOEM assumes proposed offshore wind projects will include the same or similar components as the proposed Project: wind turbines with fixed foundations, inter-array cable system, Offshore Export Cable Corridor (OECC), one or more ESPs, and onshore interconnection facilities. BOEM further assumes that other potential offshore wind projects will employ the same or similar construction, operation, and decommissioning activities as the proposed Project. Economies of scale could be realized in terms of port development and regional transmission support, as the onshore transmission systems could improve to support power incoming from multiple offshore wind projects. For purposes of this analysis, however, and as described below, BOEM assumes that each project will have its own cable (both onshore and offshore) and that future projects would not utilize regional transmission support.
- Where possible, future projects could potentially seek to collocate onshore facilities and offshore cabling systems to avoid creation of new impact areas.
- Public attitudes toward offshore wind facilities may change over time as initial projects become operational, potentially affecting potential impacts on recreation, visual resources, and socioeconomic resources and affecting how future projects are designed.
- Adaptive management could be used for many resources, particularly regulated fisheries and wildlife resources (including birds, benthic resources, finfish, invertebrates, essential fish habitat, marine mammals, and sea turtles), which would be closely monitored for potential impacts. If data collected are sufficiently robust, BOEM or other resource agencies could use the information obtained to support potential regulation changes, or new mitigation measures for future projects.
- Build-out of the U.S. offshore wind industry could displace non-renewable resources such as fossil fuel plants for power generation, resulting in a greater cumulative beneficial impact on air quality and potential reduction in regional and national greenhouse gas (GHG) emissions to address climate change.

For consideration of cumulative environmental impacts from future offshore wind projects, Table A-5 provides a list of Best Management Practices (BMPs) that were considered in the impact analysis. The BMPs were adopted from the Record of Decision (MMS 2007a) on the 2007 *Final Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf* (MMS 2007b).

[3] In addition to private and state-funded research, BOEM-funded research continues to contribute to the growing body of scientific knowledge on the marine environment and informs BOEM's decision-making regarding renewable energy planning, leasing, and development efforts. Ongoing and completed studies are listed on BOEM's website at https://www.boem.gov/Renewable-Energy-Environmental-Studies/.

Table A-4: Offshore Wind Leasing Activities in the U.S. East Coast: Projects and Assumptions

Region	Lease/Project/ Lease Remainder[1]	Status	Resource/Projects[3]						Estimated Construction Schedule[4]	Expected Turbine Size[5]	Generating Capacity (MW)						Offshore Export Cable Length (Statue Miles)[9]	Offshore Export Cable Installation Tool Disturbance Width (feet)	Inter-array Cable Length (Statue Miles)[10]	Hub Height (Feet)[11]						Rotor Diameter (Feet)[12]						Total Height of Turbine (Feet)[13]					
			Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses			Air[6]	Water[7]	Benthic[8]	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses				Air	Water/Navigation	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water/Navigation	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses
NE	Aquaventis (state waters)	State Project				X			2022	6 MW				12																							
NE	Block Island (state waters)	Built				X			Built	6 MW				30			28	5	2				328						541						659		
	Total State Waters													42			28	5	2																		
MA/RI	Vineyard Wind 1 (Proposed Action) part of OCS-A 0501	COP, PPA	X	X	X	X	X	X	2021-2022	up 14 MW	800	800	800	800	800	800	98	6.5	177	358	358	358	358	358	473	538	538	538	538	538	729	627	627	627	627	627	837
MA/RI	South Fork, part of OCS-A 0517	COP, PPA		X		X	X	X	2021-2022	8 or 12 MW		76		120	120	120	139	6.5	28		345		345	345	492		543		543	543	722		614		614	614	853
MA/RI	Sunrise, parts of OCS-A 0500 and OCS-A 0487	PPA	X	X		X	X	X	2022-2023	8 or 12 MW	405	62		880	880	880	115	6.5	169	345	345		345	345	492	543	543		543	543	722	614	614		614	614	853
MA/RI	Revolution, part of OCS-A 0486	COP, PPA	X	X		X	X	X	2022-2023	8 or 12 MW	56	665		700	700	700	40	6.5	136	345	345		345	345	492	543	543		543	543	722	614	614		614	614	853
MA/RI	Vineyard Wind South OCS-A 0501 remainder (Park City Wind)	PPA	X	X	X	X	X	X	2023-2024	8 or 12 MW	804	539	539	804	804	804	138	6.5	155	492	492	492	492	492	492	722	722	722	722	722	722	853	853	853	853	853	853
MA/RI	Mayflower (North), part of OCS-A 0521	PPA	X	X	X	X	X	X	2023-2024	8 or 12 MW	804	201	201	804	804	804	60	6.5	155	492	492	492	492	492	492	722	722	722	722	722	722	853	853	853	853	853	853
MA/RI	Bay State Wind Project, part of OCS-A 0500	COP (unpublished), the MW is included in the description below in the 7,304 MW.	X	X	X	X	X	X		12 MW										492	492	492	492	492	492	722	722	722	722	722	722	853	853	853	853	853	853
MA/RI	OCS-A 0500 and OCS-A 0487 remainder	This group may collectively support up to 5,296 MW of development--for MA (1,600 MW remaining), CT (1,196 MW remaining), and NY (up to 2,500 MW remaining). This would result in a total of 441 turbines based on the assumed 12 MW tubrine. Collectively the technical capacity is 7,304 MW.	X	X	X	X	X	X		12 MW	5,337	2,841	2,641	7,304	7,304	7,304				492	492	492	492	492	492	722	722	722	722	722	722	853	853	853	853	853	853
MA/RI	OCS-A 0520 (Equinor MA)		X	X	X	X	X	X	By 2030, spread over 2024-2030	12 MW										492	492	492	492	492	492	722	722	722	722	722	722	853	853	853	853	853	853
MA/RI	OCS-A 0521 remainder		X			X	X	X		12 MW										492			492	492	492	722			722	722	722	853			853	853	853
MA/RI	Liberty Wind, part of OCS-A 0522					X	X	X		12 MW													492	492	492				722	722	722				853	853	853
MA/RI	OCS-A 0522 remainder					X	X	X		12 MW													492	492	492				722	722	722				853	853	853
	Remaining MA/RI Lease Area Total[2]	73%									3,870	2,060	1,915	5,296	5,296	5,296	720	6.5	659																		
	Total MA/RI Leases[2]									-	6,739	4,326	3,455	9,404	9,404	9,404	1,310		1,480																		
NY/NJ	Ocean Wind, part of OCS-A 0498	COP, PPA				X			2022-2023	12 MW				1,100			142	5	142				492						722						853		
NY/NJ	Empire Wind, part of OCS-A 0512	COP, PPA				X			2023-2024	12 MW				816			64	5	107				492						722						853		
NY/NJ	Empire Wind Phase 2 and 3, part of OCS-A 0512	This group may collectively support up to 3,996 MW of development (333 turbines) from NJ and NY. Part of the NY demand is also represented under the MA/RI group as well. Collectively the technical capacity is 3,996 MW. NJ has State goals of nearly 4,000 MW that cannot be fulfilled by existing lease areas.				X				12 MW													492						722						853		
NY/NJ	Atlantic Shores OCS-A 0499					X			By 2030, spread over 2024-2030	12 MW				3,996									492						722						853		
NY/NJ	OCS-A 0498 remainder					X				12 MW													492						722						853		
	Remaining NY/NJ Lease Area Total					X								3,996			480	5	499																		
	TOTAL NY/NJ LEASES													5,912			686		748																		
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA				X			2022-2023	12 MW				120			40	10	21				492						722						853		
DE/MD	US Wind, part of OCS-A 0490	PPA				X			2022-2023	12 MW				270			80	5	40				492						722						853		
DE/MD	GSOE I, OCS-A 0482	This group may collectively support up to 1,200 MW of development from MD. NJ has almost 4,000 MW in outstanding State goals. Collectively the technical capacity of this is group is 1,908 MW (159 turbines). The remaining capacity may be utilized by demand from NJ (60 turbines).				X				12 MW													492						722						853		
	OCS-A 0519 remainder					X			By 2030, spread over 2023-2030	12 MW				1,908			360						492						722						853		
DE/MD	OCS-A 0490 remainder					X				12 MW													492						722						853		
	Remaining DE/MD Lease Area Total					X								1,908			360	5	242																		
	TOTAL DE/MD LEASES													2,298			480		303																		
VA/NC	CVOW, OCS-A 0497	Approved RAP, FDR/FIR complete				X			2020	6 MW				12			27	3.3	9				364						506						620		
VA/NC	Dominion Commercial lease, OCS-A 0483	Announced				X			2023-2026	12 MW				2,640			200	5	332				492						722						853		
VA/NC	Avangrid Renewables, OCS-A 0508	No announcement as of yet for this project. Technical capacity is 1,824 MW with 12 MW turbines and 1 x 1 nm spacing.				X			2030	12 MW				1,824			110	5	231				492						722						853		
	TOTAL VA/NC LEASES													4,476			337		572																		
	OCS Total[24, 25]:										6,739	4,326	3,455	22,090		9,404	2,841		3,105																		

Table A-4: Offshore Wind Leasing Activities in the U.S. East Coast: Projects and Assumptions

Region	Lease/Project/ Lease Remainder[1]	Status	Resource/Projects[3]						Turbine Number						Estimated Foundation Number[15]						Foundation Footprint[16] (Acres)						Seabed Disturbance Based on Addition of Scour Protection (Foundation+Scour Protection) (Acres)[17]						Offshore Export Cable Seabed Disturbance (Acres)[18]					Offshore Export Cable Operating Seabed Footprint (Acres)				
			Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air[14]	Water[14]	Benthic[14]	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses
NE	Aquaventis (state waters)	State Project				X						2						2																								
NE	Block Island (state waters)	Built				X						5						5						1						6										17		
	Total State Waters											7						7						1						6										17		
MA/RI	Vineyard Wind 1 (Proposed Action) part of OCS-A 0501	COP, PPA	X	X	X	X	X	X	100	100	100	100	100	57	102	102	102	102	102	59	2	2	2	2	2	1	53	53	53	53	53	31	117	117	117	117	117	77	77	77	77	77
MA/RI	South Fork, part of OCS-A 0517	COP, PPA		X		X	X	X		9		15	15	10		10		16	16	11		0		1	1	0		8		14	14	9	166		166	166	166	110		110	110	110
MA/RI	Sunrise, parts of OCS-A 0500 and OCS-A 0487	PPA	X	X		X	X	X	51	8		110	110	73	52	9		112	112	75	2	0		4	4	3	44	8		95	95	64	137		137	137	137	91		91	91	91
MA/RI	Revolution, part of OCS-A 0486	COP, PPA	X	X		X	X	X	7	83		88	88	59	7	85		90	90	61	0	3		4	4	2	6	72		76	76	52	48		48	48	48	32		32	32	32
MA/RI	Vineyard Wind South OCS-A 0501 remainder (Park City Wind)	PPA	X	X	X	X	X	X	101	67	67	101	101	67	103	69	69	103	103	69	4	3	3	4	4	3	87	58	58	87	87	59	164	164	164	164	164	109	109	109	109	109
MA/RI	Mayflower (North), part of OCS-A 0521	PPA	X	X	X	X	X	X	101	25	25	101	101	67	103	26	26	103	103	69	4	1	1	4	4	3	87	22	22	87	87	59	72	72	72	72	72	47	47	47	47	47
MA/RI	Bay State Wind Project, part of OCS-A 0500	COP (unpublished), the MW is included in the description below in the 7,304 MW.	X	X	X	X	X	X																																		
MA/RI	OCS-A 0500 and OCS-A 0487 remainder	This group may collectively support up to 5,296 MW of development--for MA (1,600 MW remaining), CT (1,196 MW remaining), and NY (up to 2,500 MW remaining). This would result in a total of 441 turbines based on the assumed 12 MW tubrine. Collectively the technical capacity is 7,304 MW.	X	X	X	X	X	X	445	237	220	609	609	610	454	242	225	621	621	622	18	10	9	25	25	25	386	206	191	528	528	529	428	428	856	856	856	284	284	567	567	567
MA/RI	OCS-A 0520 (Equinor MA)		X	X	X	X	X	X																																		
MA/RI	OCS-A 0521 remainder		X			X	X	X																																		
MA/RI	Liberty Wind, part of OCS-A 0522					X	X	X																																		
MA/RI	OCS-A 0522 remainder					X	X	X																																		
	Remaining MA/RI Lease Area Total[2]	73%							322	172	160	441	441	442	329	175	163	450	450	451	13	7	7	18	18	18	280	149	139	383	383	383	428	428	856	856	856	284	284	567	567	567
	Total MA/RI Leases[2]								681	464	352	955	955	775	695	475	359	975	975	795	26	17	12	37	37	31	557	370	272	795	795	413	1,132	781	1,560	1,560	1,560	749	517	1,032	1,032	1,032
NY/NJ	Ocean Wind, part of OCS-A 0498	COP, PPA				X						92						94						4						80					169					86		
NY/NJ	Empire Wind, part of OCS-A 0512	COP, PPA				X						68						70						3						60					77					39		
NY/NJ	Empire Wind Phase 2 and 3, part of OCS-A 0512	This group may collectively support up to 3,996 MW of development (333 turbines) from NJ and NY. Part of the NY demand is also represented under the MA/RI group as well. Collectively the technical capacity is 3,996 MW. NJ has State goals of nearly 4,000 MW that cannot be fulfilled by existing lease areas.				X																																				
NY/NJ	Atlantic Shores OCS-A 0499					X						333						340																								
NY/NJ	OCS-A 0498 remainder					X																																				
	Remaining NY/NJ Lease Area Total					X						333						340						14						289					571					291		
	TOTAL NY/NJ LEASES											493						504						20						428					817					416		
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA				X						10						11						0.4						9					48					50		
DE/MD	US Wind, part of OCS-A 0490	PPA				X						23						24						1						20					96					48		
DE/MD	GSOE I, OCS-A 0482	This group may collectively support up to 1,200 MW of development from MD. NJ has almost 4,000 MW in outstanding State goals. Collectively the technical capacity of this is group is 1,908 MW (159 turbines). The remaining capacity may be utilized by demand from NJ (60 turbines).				X																																				
	OCS-A 0519 remainder					X						159						163																								
DE/MD	OCS-A 0490 remainder					X																																				
	Remaining DE/MD Lease Area Total					X						159						163						7						139					428					218		
	TOTAL DE/MD LEASES											192						198						8						168					572					317		
VA/NC	CVOW, OCS-A 0497	Approved RAP, FDR/FIR complete				X						2						2						0.08						2					33					11		
VA/NC	Dominion Commercial lease, OCS-A 0483	Announced				X						220						225						9						191					238					121		
VA/NC	Avangrid Renewables, OCS-A 0508	No announcement as of yet for this project. Technical capacity is 1,824 MW with 12 MW turbines and 1 x 1 nm spacing.				X						152						155						6						132					131					67		
	TOTAL VA/NC LEASES											374						382						15						325					402					199		
	OCS Total[24, 25]:								681		352	2,021		775	695		359	2,066		795	26		12	81		31	557		272	1,723			1,132		3,351			749	517	1,981		

Table A-4: Offshore Wind Leasing Activities in the U.S. East Coast: Projects and Assumptions

Region	Lease/Project/ Lease Remainder[1]	Status	Resource/Projects[3]						Offshore Export Cable Hard Protection (Acres)[19]					Anchoring Disturbance (Acres)[20]					Inter-array Construction Footprint/ Seabed Disruption (Acres)[21]					Inter-array Operating Footprint/ Seabed Disruption (Acres)[22]					Inter-array Cable Hard Protection (Acres)[23]				
			Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses
NE	Aquaventis (state waters)	State Project				X																											
NE	Block Island (state waters)	Built				X															4					0.1					0.01		
	Total State Waters										0					0					4					0.1					0.01		
MA/RI	Vineyard Wind 1 (Proposed Action) part of OCS-A 0501	COP, PPA	X	X	X	X	X	X	35	35	35	35	35	4	4	4	4	4	204	204	204	204	116	146	146	146	146	84	63	63	63	63	44
MA/RI	South Fork, part of OCS-A 0517	COP, PPA		X		X	X	X	50		50	50	50	14		14	14	14	23		36	36	24	14		23	23	16	14		12	12	8
MA/RI	Sunrise, parts of OCS-A 0500 and OCS-A 0487	PPA	X	X		X	X	X	41		41	41	41	12		12	12	12	18		264	264	175	13		160	160	107	0		0	0	0
MA/RI	Revolution, part of OCS-A 0486	COP, PPA	X	X		X	X	X	14		14	14	14	4		4	4	4	200		211	211	142	121		128	128	87	121		66	66	45
MA/RI	Vineyard Wind South OCS-A 0501 remainder (Park City Wind)	PPA	X	X	X	X	X	X	49	49	49	49	49	14	14	14	14	14	162	162	241	241	161	98	98	147	147	99	98	51	76	76	51
MA/RI	Mayflower (North), part of OCS-A 0521	PPA	X	X	X	X	X	X	21	21	21	21	21	6	6	6	6	6	60	60	241	241	161	37	37	147	147	99	0	0	0	0	0
MA/RI	Bay State Wind Project, part of OCS-A 0500	COP (unpublished), the MW is included in the description below in the 7,304 MW.	X	X	X	X	X	X																									
MA/RI	OCS-A 0500 and OCS-A 0487 remainder	This group may collectively support up to 5,296 MW of development--for MA (1,600 MW remaining), CT (1,196 MW remaining), and NY (up to 2,500 MW remaining). This would result in a total of 441 turbines based on the assumed 12 MW tubrine. Collectively the technical capacity is 7,304 MW.	X	X	X	X	X	X	129	129	257	257	257	36	36	72	72	72	568	528	1,461	1,461	1,463	346	322	888	888	889	0	0	0	0	0
MA/RI	OCS-A 0520 (Equinor MA)		X	X	X	X	X	X																									
MA/RI	OCS-A 0521 remainder		X			X	X	X																									
MA/RI	Liberty Wind, part of OCS-A 0522					X	X	X																									
MA/RI	OCS-A 0522 remainder					X	X	X																									
	Remaining MA/RI Lease Area Total[2]	73%							129	129	257	257	257	36	36	72	72	72	412	383	1,059	1,059	1,061	251	233	644	644	645	0	0	0	0	0
	Total MA/RI Leases[2]								339	234	468	468	468	90	60	126	126	126	1,079	809	2,257	2,257	1,840	679	514	1,395	1,395	1,137	296	114	217	217	148
NY/NJ	Ocean Wind, part of OCS-A 0498	COP, PPA				X					51					14					221					134					0		
NY/NJ	Empire Wind, part of OCS-A 0512	COP, PPA				X					23					6					163					100					0		
NY/NJ	Empire Wind Phase 2 and 3, part of OCS-A 0512	This group may collectively support up to 3,996 MW of development (333 turbines) from NJ and NY. Part of the NY demand is also represented under the MA/RI group as well. Collectively the technical capacity is 3,996 MW. NJ has State goals of nearly 4,000 MW that cannot be fulfilled by existing lease areas.				X																											
NY/NJ	Atlantic Shores OCS-A 0499					X																											
NY/NJ	OCS-A 0498 remainder					X																											
	Remaining NY/NJ Lease Area Total					X					171					48					799					486					0		
	TOTAL NY/NJ LEASES										245					69					1,183					721					0		
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA				X					14					4					24					16					0		
DE/MD	US Wind, part of OCS-A 0490	PPA				X					29					8					55					34					0		
DE/MD	GSOE I, OCS-A 0482	This group may collectively support up to 1,200 MW of development from MD. NJ has almost 4,000 MW in outstanding State goals. Collectively the technical capacity of this is group is 1,908 MW (159 turbines). The remaining capacity may be utilized by demand from NJ (60 turbines).				X																											
	OCS-A 0519 remainder					X																											
DE/MD	OCS-A 0490 remainder					X																											
	Remaining DE/MD Lease Area Total					X					129					36					382					233					0		
	TOTAL DE/MD LEASES										171					48					461					283					0		
VA/NC	CVOW, OCS-A 0497	Approved RAP, FDR/FIR complete				X					10					3					5					3					0		
VA/NC	Dominion Commercial lease, OCS-A 0483	Announced				X					71					20					528					322					0		
VA/NC	Avangrid Renewables, OCS-A 0508	No announcement as of yet for this project. Technical capacity is 1,824 MW with 12 MW turbines and 1 x 1 nm spacing.				X					39					11					365					222					0		
	TOTAL VA/NC LEASES										120					34					898					546					0		
	OCS Total[24, 25]:								339		1,004			90		276			1,079		4,802			679		2,945			296		217		

Table A-4: Offshore Wind Leasing Activities in the U.S. East Coast: Projects and Assumptions

Region	Lease/Project/ Lease Remainder[1]	Status	Resource/Projects[3]						Total of Coolant fluids in WTGs (gallons)						Total Coolant fluids in ESP (gallons)						Total of Oils and Lubricants in WTGs (gallons)					
			Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses
NE	Aquaventis (state waters)	State Project				X																				
NE	Block Island (state waters)	Built				X																				
	Total State Waters																									
MA/RI	Vineyard Wind 1 (Proposed Action) part of OCS-A 0501	COP, PPA	X	X	X	X	X	X	42,300	42,300	42,300	42,300	42,300	24,111	46	46	46	46	46	46	383,000	383,000	383,000	383,000	383,000	218,310
MA/RI	South Fork, part of OCS-A 0517	COP, PPA		X		X	X	X		3,997		6,345	6,345	4,230		4		23	23	23		36,194		57,450	57,450	38,300
MA/RI	Sunrise, parts of OCS-A 0500 and OCS-A 0487	PPA	X	X		X	X	X	21,404	3,257		46,530	46,530	30,879	23	27		51	51	46	193,798	29,491		421,300	421,300	279,590
MA/RI	Revolution, part of OCS-A 0486	COP, PPA	X	X		X	X	X	2,961	35,162		37,224	37,224	24,957	3	38		40	40	46	26,810	318,369		337,040	337,040	225,970
MA/RI	Vineyard Wind South OCS-A 0501 remainder (Park City Wind)	PPA	X	X	X	X	X	X	42,512	28,483	28,483	42,512	42,512	28,341	46	31	31	46	46	46	384,915	257,893	257,893	384,915	384,915	256,610
MA/RI	Mayflower (North), part of OCS-A 0521	PPA	X	X	X	X	X	X	42,512	10,628	10,628	42,512	42,512	28,341	46	12	12	46	46	46	384,915	96,229	96,229	384,915	384,915	256,610
MA/RI	Bay State Wind Project, part of OCS-A 0500	COP (unpublished), the MW is included in the description below in the 7,304 MW.	X	X	X	X	X	X																		
MA/RI	OCS-A 0500 and OCS-A 0487 remainder	This group may collectively support up to 5,296 MW of development--for MA (1,600 MW remaining), CT (1,196 MW remaining), and NY (up to 2,500 MW remaining). This would result in a total of 441 turbines based on the assumed 12 MW tubrine. Collectively the technical capacity is 7,304 MW.	X	X	X	X	X	X	188,128	100,150	93,113	257,466	257,466	257,889	213	120	112	284	284	284	1,703,383	906,799	843,078	2,331,193	2,331,193	2,335,023
MA/RI	OCS-A 0520 (Equinor MA)		X	X	X	X	X	X																		
MA/RI	OCS-A 0521 remainder		X			X	X	X																		
MA/RI	Liberty Wind, part of OCS-A 0522					X	X	X																		
MA/RI	OCS-A 0522 remainder					X	X	X																		
	Remaining MA/RI Lease Area Total[2]	73%							136,408	72,617	67,514	186,684	186,684	186,991	154	87	81	206	206	206	1,235,092	657,504	611,301	1,690,307	1,690,307	1,693,084
	Total MA/RI Leases[2]								288,096	196,444	148,925	404,106	404,106	327,850	319	245	170	458	458	459	2,608,530	1,778,679	1,348,423	3,658,927	3,658,927	2,968,474
NY/NJ	Ocean Wind, part of OCS-A 0498	COP, PPA				X						38,916						46						352,360		
NY/NJ	Empire Wind, part of OCS-A 0512	COP, PPA				X						28,764						46						260,440		
NY/NJ	Empire Wind Phase 2 and 3, part of OCS-A 0512	This group may collectively support up to 3,996 MW of development (333 turbines) from NJ and NY. Part of the NY demand is also represented under the MA/RI group as well. Collectively the technical capacity is 3,996 MW. NJ has State goals of nearly 4,000 MW that cannot be fulfilled by existing lease areas.				X																				
NY/NJ	Atlantic Shores OCS-A 0499					X																				
NY/NJ	OCS-A 0498 remainder					X																				
	Remaining NY/NJ Lease Area Total					X						140,859						161						1,275,390		
	TOTAL NY/NJ LEASES											208,539						253						1,888,190		
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA				X						4,230						46						38,300		
DE/MD	US Wind, part of OCS-A 0490	PPA				X						9,729						46						88,090		
DE/MD	GSOE I, OCS-A 0482	This group may collectively support up to 1,200 MW of development from MD. NJ has almost 4,000 MW in outstanding State goals. Collectively the technical capacity of this is group is 1,908 MW (159 turbines). The remaining capacity may be utilized by demand from NJ (60 turbines).				X																				
	OCS-A 0519 remainder					X																				
DE/MD	OCS-A 0490 remainder					X																				
	Remaining DE/MD Lease Area Total					X						67,257						92						608,970		
	TOTAL DE/MD LEASES											81,216						184						735,360		
VA/NC	CVOW, OCS-A 0497	Approved RAP, FDR/FIR complete				X						846						0						7,660		
VA/NC	Dominion Commercial lease, OCS-A 0483	Announced				X						93,060						115						842,600		
VA/NC	Avangrid Renewables, OCS-A 0508	No announcement as of yet for this project. Technical capacity is 1,824 MW with 12 MW turbines and 1 x 1 nm spacing.				X						64,296						69						582,160		
	TOTAL VA/NC LEASES											158,202						184						1,432,420		
	OCS Total[24, 25]:											852,063						1,079						7,714,897		

Table A-4: Offshore Wind Leasing Activities in the U.S. East Coast: Projects and Assumptions

Region	Lease/Project/ Lease Remainder[1]	Status	Resource/Projects[3]						Total Oils and Lubricants in ESP (gallons)						Total Diesel Fuel in WTGs (gallons)						Total Diesel Fuel in ESP (gallons)					
			Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses
NE	Aquaventis (state waters)	State Project				X																				
NE	Block Island (state waters)	Built				X																				
	Total State Waters																									
MA/RI	Vineyard Wind 1 (Proposed Action) part of OCS-A 0501	COP, PPA	X	X	X	X	X	X	123,559	123,559	123,559	123,559	123,559	123,559	79,300	79,300	79,300	79,300	79,300	45,201	5,696	5,696	5,696	5,696	5,696	5,696
MA/RI	South Fork, part of OCS-A 0517	COP, PPA		X		X	X	X		11,676		61,780	61,780	61,780		7,494		11,895	11,895	7,930		538		2,848	2,848	2,848
MA/RI	Sunrise, parts of OCS-A 0500 and OCS-A 0487	PPA	X	X		X	X	X	62,521	71,294		135,915	135,915	123,559	40,126	6,106		87,230	87,230	57,889	2,882	3,287		6,266	6,266	5,696
MA/RI	Revolution, part of OCS-A 0486	COP, PPA	X	X		X	X	X	8,649	102,708		108,732	108,732	123,559	5,551	65,918		69,784	69,784	46,787	399	4,735		5,012	5,012	5,696
MA/RI	Vineyard Wind South OCS-A 0501 remainder (Park City Wind)	PPA	X	X	X	X	X	X	124,177	83,198	83,198	124,177	124,177	123,559	79,697	53,397	53,397	79,697	79,697	53,131	5,724	3,835	3,835	5,724	5,724	5,696
MA/RI	Mayflower (North), part of OCS-A 0521	PPA	X	X	X	X	X	X	124,177	31,044	31,044	124,177	124,177	123,559	79,697	19,924	19,924	79,697	79,697	53,131	5,724	1,431	1,431	5,724	5,724	5,696
MA/RI	Bay State Wind Project, part of OCS-A 0500	COP (unpublished), the MW is included in the description below in the 7,304 MW.	X	X	X	X	X	X																		
MA/RI	OCS-A 0500 and OCS-A 0487 remainder	This group may collectively support up to 5,296 MW of development--for MA (1,600 MW remaining), CT (1,196 MW remaining), and NY (up to 2,500 MW remaining). This would result in a total of 441 turbines based on the assumed 12 MW tubrine. Collectively the technical capacity is 7,304 MW.	X	X	X	X	X	X	571,618	323,591	301,186	761,947	761,947	761,947	352,685	187,752	174,559	482,673	482,673	483,466	26,351	14,917	13,885	35,125	35,125	35,125
MA/RI	OCS-A 0520 (Equinor MA)		X	X	X	X	X	X																		
MA/RI	OCS-A 0521 remainder		X			X	X	X																		
MA/RI	Liberty Wind, part of OCS-A 0522					X	X	X																		
MA/RI	OCS-A 0522 remainder					X	X	X																		
	Remaining MA/RI Lease Area Total[2]	73%							414,470	234,630	218,385	552,474	552,474	552,474	255,725	136,136	126,570	349,977	349,977	350,552	19,107	10,816	10,067	25,469	25,469	25,469
	Total MA/RI Leases[2]								857,553	658,110	456,186	1,230,813	1,230,813	1,232,049	540,095	368,275	279,190	757,579	757,579	614,621	39,533	30,338	21,030	56,740	56,740	56,797
NY/NJ	Ocean Wind, part of OCS-A 0498	COP, PPA				X						123,559						72,956						5,696		
NY/NJ	Empire Wind, part of OCS-A 0512	COP, PPA				X						123,559						53,924						5,696		
NY/NJ	Empire Wind Phase 2 and 3, part of OCS-A 0512	This group may collectively support up to 3,996 MW of development (333 turbines) from NJ and NY. Part of the NY demand is also represented under the MA/RI group as well. Collectively the technical capacity is 3,996 MW. NJ has State goals of nearly 4,000 MW that cannot be fulfilled by existing lease areas.				X																				
NY/NJ	Atlantic Shores OCS-A 0499					X																				
NY/NJ	OCS-A 0498 remainder					X																				
	Remaining NY/NJ Lease Area Total					X						432,457						264,069						19,936		
	TOTAL NY/NJ LEASES											679,575						390,949						31,328		
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA				X						61,780						7,930						2,848		
DE/MD	US Wind, part of OCS-A 0490	PPA				X						61,780						18,239						2,848		
DE/MD	GSOE I, OCS-A 0482	This group may collectively support up to 1,200 MW of development from MD. NJ has almost 4,000 MW in outstanding State goals. Collectively the technical capacity of this is group is 1,908 MW (159 turbines). The remaining capacity may be utilized by demand from NJ (60 turbines).				X																				
	OCS-A 0519 remainder					X																				
DE/MD	OCS-A 0490 remainder					X																				
	Remaining DE/MD Lease Area Total					X						247,118						126,087						11,392		
	TOTAL DE/MD LEASES											370,677						152,256						17,088		
VA/NC	CVOW, OCS-A 0497	Approved RAP, FDR/FIR complete				X						0						1,586						0		
VA/NC	Dominion Commercial lease, OCS-A 0483	Announced				X						308,898						174,460						14,240		
VA/NC	Avangrid Renewables, OCS-A 0508	No announcement as of yet for this project. Technical capacity is 1,824 MW with 12 MW turbines and 1 x 1 nm spacing.				X						185,339						120,536						8,544		
	TOTAL VA/NC LEASES											494,236						296,582						22,784		
	OCS Total[24, 25]:											2,775,301						1,597,366						127,940		

Table A-4: Offshore Wind Leasing Activities in the U.S. East Coast: Projects and Assumptions

Region	Lease/Project/ Lease Remainder[1]	Status	Resource/Projects[3]						Construction Emissions NOx (tons)	Construction Emissions VOC (tons)	Construction Emissions CO (tons)	Construction Emissions PM10 (tons)	Construction Emissions PM2.5 (tons)	Construction Emissions SO2 (tons)	Construction Emissions CO2 (tons)	Operation Emissions NOx (tpy)	Operation Emissions VOC (tpy)	Operation Emissions CO (tpy)	Operation Emissions PM10 (tpy)	Operation Emissions PM2.5 (tpy)	Operation Emissions SO2 (tpy)	Operation Emissions CO2 (tpy)
			Air	Water	Benthic	Birds/Bats/Finfish-Invertebrates-EFH/Marine Mammals/Sea Turtles/Commercial Fisheries	Navigation	Demographics/Environmental Justice/Cultural/Visual/ Recreation-Tourism/Other Uses	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air
NE	Aquaventis (state waters)	State Project				X																
NE	Block Island (state waters)	Built				X																
	Total State Waters																					
MA/RI	Vineyard Wind 1 (Proposed Action) part of OCS-A 0501	COP, PPA	X	X	X	X	X	X	4,961	122	1,116	172	166	38	318,660	71	2	18	2	2	0.3	5,487
MA/RI	South Fork, part of OCS-A 0517	COP, PPA		X		X	X	X														
MA/RI	Sunrise, parts of OCS-A 0500 and OCS-A 0487	PPA	X	X		X	X	X	2,510	61	565	87	84	19	161,242	36	1	9	1	1	0	2,776
MA/RI	Revolution, part of OCS-A 0486	COP, PPA	X	X		X	X	X	347	9	78	12	12	3	22,306	5	0	1	0	0	0	384
MA/RI	Vineyard Wind South OCS-A 0501 remainder (Park City Wind)	PPA	X	X	X	X	X	X	4,986	122	1,121	173	167	38	320,253	71	2	18	2	2	0	5,514
MA/RI	Mayflower (North), part of OCS-A 0521	PPA	X	X	X	X	X	X	4,986	122	1,121	173	167	38	320,253	71	2	18	2	2	0	5,514
MA/RI	Bay State Wind Project, part of OCS-A 0500	COP (unpublished), the MW is included in the description below in the 7,304 MW.	X	X	X	X	X	X														
MA/RI	OCS-A 0500 and OCS-A 0487 remainder	This group may collectively support up to 5,296 MW of development--for MA (1,600 MW remaining), CT (1,196 MW remaining), and NY (up to 2,500 MW remaining). This would result in a total of 441 turbines based on the assumed 12 MW tubrine. Collectively the technical capacity is 7,304 MW.	X	X	X	X	X	X														
MA/RI	OCS-A 0520 (Equinor MA)		X	X	X	X	X	X														
MA/RI	OCS-A 0521 remainder		X			X	X	X														
MA/RI	Liberty Wind, part of OCS-A 0522					X	X	X														
MA/RI	OCS-A 0522 remainder					X	X	X														
	Remaining MA/RI Lease Area Total[2]	73%							16,011	392	3,601	556	535	124	1,028,420	228	6	58	8	7	1	17,708
	Total MA/RI Leases[2]								33,801	828	7,602	1,175	1,129	261	2,171,135	482	14	123	16	16	2	37,385
NY/NJ	Ocean Wind, part of OCS-A 0498	COP, PPA				X																
NY/NJ	Empire Wind, part of OCS-A 0512	COP, PPA				X																
NY/NJ	Empire Wind Phase 2 and 3, part of OCS-A 0512	This group may collectively support up to 3,996 MW of development (333 turbines) from NJ and NY. Part of the NY demand is also represented under the MA/RI group as well. Collectively the technical capacity is 3,996 MW. NJ has State goals of nearly 4,000 MW that cannot be fulfilled by existing lease areas.				X																
NY/NJ	Atlantic Shores OCS-A 0499					X																
NY/NJ	OCS-A 0498 remainder					X																
	Remaining NY/NJ Lease Area Total					X																
	TOTAL NY/NJ LEASES																					
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA				X																
DE/MD	US Wind, part of OCS-A 0490	PPA				X																
DE/MD	GSOE I, OCS-A 0482	This group may collectively support up to 1,200 MW of development from MD. NJ has almost 4,000 MW in outstanding State goals. Collectively the technical capacity of this is group is 1,908 MW (159 turbines). The remaining capacity may be utilized by demand from NJ (60 turbines).				X																
	OCS-A 0519 remainder					X																
DE/MD	OCS-A 0490 remainder					X																
	Remaining DE/MD Lease Area Total					X																
	TOTAL DE/MD LEASES																					
VA/NC	CVOW, OCS-A 0497	Approved RAP, FDR/FIR complete				X																
VA/NC	Dominion Commercial lease, OCS-A 0483	Announced				X																
VA/NC	Avangrid Renewables, OCS-A 0508	No announcement as of yet for this project. Technical capacity is 1,824 MW with 12 MW turbines and 1 x 1 nm spacing.				X																
	TOTAL VA/NC LEASES																					
	OCS Total[24, 25]:																					

Notes: COP = Construction and Operations Plan, CT = Connecticut, DE = Delaware, ESP = electrical service platform, FDR = Facility Design Report, FIR = Fabrication and Installation Report, km^2 = square kilometers, MA = Massachusetts, MD = Maryland, MW = megawatt, NE = New England, NJ = New Jersey, NY = New York, PPA = Power Purchase Agreement, RAP = Research Activities Plan, RI = Rhode Island, tpy = tons per year, WTG = wind turbine generator

1. The spacing/layout for projects/regions are as follows: NE State water projects include a single strand of WTGs and no ESPs; for projects in the RI and MA Lease Areas, the analysis for the Vineyard Wind 1 Project assumes the spacing/layout is specific to the Proposed Action or action alternatives presented in SEIS Chapter 2; however, Vineyard Wind has stated they would utilize a 1 nautical mile x 1 nautical mile grid spacing. A 1 nautical mile x 1 nautical mile grid spacing is assumed for all other projects in the RI and MA Lease Areas; for the projects in the New Jersey/New York and the Delaware/Maryland lease areas, BOEM assumes that a 1 nautical mile x 1 nautical mile grid spacing also would be utilized; for the Coastal Virginia Offshore Wind Project, the spacing is 0.7 nautical mile; and the Dominion commercial lease area off the coast of Virginia would utilize 0.5 nautical mile average spacing, which is less than the 1 x 1 nautical mile spacing due to the need to attain the state's goals.
2. Because development could occur anywhere within the RI and MA Lease Areas and assumes a continuous 1 x 1 nautical mile grid, the actual development for these projects is expected to be approximately 73 percent of the collective technical capacity. Under the cumulative scenario described in Chapter 1, the total area in the RI and MA Lease Areas is greater than the area needed to meet state demand. Therefore, if a project is not constructed, BOEM assumes that another future project would be constructed to fulfill the unmet demand.
3. This column identifies lease areas that are applicable to each resource based on the geographic analysis areas shown on Figures A.7-1 through A.7-16. Except for known locations of special value or sensitivity with regard to a resource, BOEM assumes all locations within a geographic analysis area exhibit similar levels of sensitivity to potential impacts. Accordingly, a location at the periphery of a geographic analysis area is equally sensitive to potential impacts of other future offshore wind activities as is a location within Vineyard Wind's proposed Project footprint.
4. The estimated construction schedule is based on information known at the time of this analysis and could be different when an applicant submits a COP. Furthermore, for this cumulative analysis BOEM assumes that construction all the foundations would be installed during year 1 of construction and the balance of the work would be completed in year 2.
5. It is difficult to accurately predict future technology for planned but currently unscheduled offshore wind awards, including turbine spacing and capacity. For those projects with announced WTG sizes, BOEM used the assumption of an 8- or 12-MW WTG based on maximum-impact case for the resource. BOEM understands that it is feasible that in the future, turbine capacity could be greater than 12 MW. For future procurements and projects under this cumulative analysis, BOEM assumes the largest turbine that is presently commercially available, a 12-MW WTG, to evaluate potential impacts.
6. The generating capacity for the lease areas within the air quality geographic analysis area without a known project size has been assumed to be a percentage of the technical capacity (7,304 MW). The percentage (73 percent) has been calculated based on the amount of lease area acreage for the specific lease areas (359,146 acres [1,453 km^2]) divided by the remaining "MA/RI Lease Area" total (491,515 acres [1,989 km^2]). The air quality geographic analysis area includes 100 percent of the following leases: Bay State Wind Project, part of OCS-A 0500; OCS-A 0500 and OCS-A 0487 remainder; OCS-A 0520 (Equinor MA); and OCS-A 0521 remainder.
7. The generating capacity for the lease areas within the water quality geographic analysis area without a known project size has been assumed to be a percentage of the technical capacity (7,304 MW). The percentage (63%) has been calculated based on the amount of lease area acreage for the specific lease areas (310,041 acres [1,255 km^2]) divided by the remaining "MA/RI lease area" total (491,515 acres [1,989 km^2]). The water quality geographic analysis area includes the following leases: 100 percent of Bay State Wind Project, part of OCS-A 0500; 22 percent of OCS-A 0500 and OCS-A 0487 remainder; and 63 percent of OCS-A 0520 (Equinor MA).
8. The generating capacity for the lease areas within the benthic resources geographic analysis area without a known project size has been assumed to be a percentage of the technical capacity (7,304 MW). The percentage (63 percent) has been calculated based on the amount of lease area acreage for the specific lease areas (310,041 acres [1,255 km^2]) divided by the "MA/RI Lease Area" total (491,515 acres [1,989 km^2]). The benthic resources geographic analysis areas includes the following leases: 100 percent of the Bay State Wind Project, part of OCS-A 0500; 9 percent of OCS-A 0500 and OCS-A 0487 remainder; and 63 percent of OCS-A 0520 (Equinor MA).
9. BOEM assumes that each offshore wind development would have its own cable (both onshore and offshore) and that future projects would not utilize a regional transmission line. The length of offshore export cable for those lease areas without a known project size has been assumed to include two offshore cables totaling 120 miles (193 kilometers). The offshore export cable would be buried a minimum of 6 feet (1.8 meters) but not more than 10 feet (3.1 meters).
10. The length of inter-array cabling has been assumed for all lease areas, except Vineyard Wind 1 Project, to be the average amount per foundation based on the COPs submitted to date, which is 1.48 miles (2.4 kilometers). In addition, for those lease areas that require more than one ESP, it has been assumed that an additional 6.2 miles (9.9 kilometers) of inter-link cable would be required to link the two ESPs. Inter-array cable is assumed to be buried between 4 and 6 feet.
11. The hub height for lease areas is based on worst-case scenario for the resource area.
12. The rotor diameter for lease areas is based on worst-case scenario for the resource area.
13. The total height of the turbine for lease areas is based on worst-case scenario for the resource area.
14. The number of turbines for those lease areas without a known project size has been calculated based on the generating capacity and a 12-MW turbine.
15. The estimated number of foundations is the total number of turbines plus ESPs, and it has been assumed that for every 50 turbines there would be 1 ESP installed. There are some exceptions to this assumption where additional relevant information is available in publically available COPs for future projects.
16. The foundation footprint has been assumed to be 0.04 acre (161 square meters), which is based on the largest monopile reported (12 MW) for all lease areas other than Vineyard Wind 1 Project, which is 0.02 acres (81 square meters) as calculated from SEIS Appendix E.
17. The seabed disturbance with the addition of scour protection was calculated based on scour protection expected in submitted COPs. The Vineyard Wind 1 Project is based off the amount calculated from the COP and SEIS Appendix E. It is assumed that for all other lease areas that a 12-MW foundation with addition of scour protection would be 0.85 acres (3,440 square meters) per foundation.
18. Offshore export cable seabed bottom disturbance is assumed to be due to installation of the export cable, the use of jack-up vessels, and the need to perform dredging.
19. The offshore export cable hard protection is assumed to be similar to Vineyard Wind 1 Project, which is 0.357 acres (1,445 square meters) per mile of offshore export cable. It is assumed that 10 percent of the offshore export cable would require protection.
20. Anchoring disturbance has been assumed to be a rate equal to 0.10 acres (405 square meters) per mile of offshore export cable for all lease areas with the exception of Vineyard Wind 1 Project, which is 0.044 acres per mile of offshore export cable as calculated per SEIS Appendix E. Vineyard Wind has stated dynamic positioning vessels would be used and anchoring would occur only along the offshore export cable route.
21. Inter-array construction seabed disturbance has been assumed to be a rate equal to the average area per foundation, 2.4 acres (9,712 square meters) per foundation, for all lease areas with the exception of Vineyard Wind 1 Project, which is 2.04 acres (8,256 square meters) per foundation as calculated from the COP and SEIS Appendix E.
22. The inter-array operating footprint is assumed to be a rate equal to the average amount per foundation of 1.43 acres (5,787 square meters) per foundation for all lease areas.
23. Inter-array cable hard protection is assumed to be zero for all lease areas with the exception of Vineyard Wind 1 Project, Vineyard Wind South OCS-A-5001, South Fork, part of OCS-A 0486 and Revolution Wind, part of OCS-A 0486.
24. BOEM recognizes that the estimates presented within this cumulative analysis are likely high, conservative estimates; however, BOEM believes that this analysis is appropriately capturing the potential cumulative impacts and errs on the side of maximum impacts.
25. New York's demand is not double-counted, this total comes from looking at New York's state demand, not adding up the potential of the areas because that would double-count New York.

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Table A-5: Best Management Practices for Future Offshore Wind Activities

Preconstruction Planning
Lessees and grantees shall minimize the area disturbed by preconstruction site monitoring and testing activities and installations.
Lessees and grantees shall contact and consult with the appropriate affected federal, state, and local agencies early in the planning process.
Lessees and grantees shall consolidate necessary infrastructure requirements between projects whenever practicable.
Lessees and grantees shall develop a monitoring program to ensure that environmental conditions are monitored during construction, operation, and decommissioning phases. The monitoring program requirements, including adaptive management strategies, shall be established at the project level to ensure that potential adverse impacts are mitigated.
Seafloor Habitats
Lessees and grantees shall conduct seafloor surveys in the early phases of a project to ensure that the alternative energy project is sited appropriately to avoid or minimize potential impacts associated with seafloor instability or other hazards.
Lessees and grantees shall conduct appropriate pre-siting surveys to identify and characterize potentially sensitive seafloor habitats and topographic features.
Lessees and grantees shall avoid locating facilities near known sensitive seafloor habitats, such as coral reefs, hard-bottom areas, and chemosynthetic communities.
Lessees and grantees shall avoid anchoring on sensitive seafloor habitats.
Lessees and grantees shall minimize seafloor disturbance during construction and installation of the facility and associated infrastructure.
Lessees and grantees shall employ appropriate shielding for underwater cables to control the intensity of electromagnetic fields.
Lessees and grantees shall reduce scouring action by ocean currents around foundations and to seafloor topography by taking all reasonable measures and employing periodic routine inspections to ensure structural integrity.
Lessees and grantees shall take all reasonable actions to minimize seabed disturbance and sediment dispersion during cable installation.
Marine Mammals
Lessees and grantees shall evaluate marine mammal use of the proposed project area and design the project to minimize and mitigate the potential for mortality or disturbance. The amount and extent of ecological baseline data required will be determined on a project basis.
Vessels related to project planning, construction, and operation shall travel at reduced speeds when assemblages of cetaceans are observed and maintain a reasonable distance from whales, small cetaceans, and sea turtles as determined during site-specific consultations.
Lessees and grantees shall minimize potential vessel impacts on marine mammals and sea turtles by requiring project-related vessels to follow the NMFS and BOEM requirements while in transit. Operators shall be required to undergo training on applicable vessel requirements.
Lessees and grantees shall take efforts to minimize disruption and disturbance to marine life from sound emissions, such as pile driving, during construction activities.
Lessees and grantees shall avoid and minimize impacts on marine species and habitat in the project area by posting a qualified observer approved by BOEM and NMFS on-site during construction activities.
Fish Resources and Essential Fish Habitat
Lessees and grantees shall conduct pre-siting surveys (may use existing data) to identify important, sensitive, and unique marine habitats in the vicinity of the project and design the project to avoid, minimize, or otherwise mitigate adverse impacts on these habitats.
Lessees and grantees shall minimize construction activities in areas containing anadromous fish during migration periods.
Lessees and grantees shall minimize seafloor disturbance during construction and installation of the facility and associated infrastructure.
Sea Turtles
Lessees and grantees shall minimize potential vessel impacts on marine mammals and sea turtles by requiring project-related vessels to follow the NMFS Regional Viewing Guidelines while in transit. Operators shall be required to undergo training on applicable vessel guidelines.
Lessees and grantees shall take efforts to minimize disruption and disturbance to marine life from sound emissions, such as pile driving, during construction activities.
Lessees and grantees shall locate cable landfalls and onshore facilities so as to avoid impacts on known nesting beaches.
Avian Resources
Lessees shall evaluate avian use of the project area and design the project to minimize or mitigate the potential for bird strikes and habitat loss. The amount and extent of ecological baseline data required will be determined on a project-by-project basis.
Lessees and grantees shall take measures to reduce perching opportunities.
Lessees and grantees shall locate cable landfalls and onshore facilities so as to avoid impacts on known nesting beaches.
Lessees and grantees shall comply with FAA and USCG requirements for lighting while using lighting technology (e.g., low-intensity strobe lights) that minimizes impacts on avian species.
Acoustic Environment
Lessees and grantees should plan site characterization surveys by using the lowest sound levels necessary to obtain the information needed.
Lessees and grantees shall take efforts to minimize disruption and disturbance to marine life from sound emissions, such as pile driving, during construction activities.
Lessees and grantees shall employ, to the extent practicable, state-of-the- art, low-noise turbines or other technologies to minimize operational sound impacts.

Fisheries
Lessees and grantees shall work cooperatively with commercial/recreational fishing entities and interests to ensure that the construction and operation of a project will minimize potential conflicts with commercial and recreational fishing interests.
Lessees and grantees shall review planned activities with potentially affected fishing organizations and port authorities to prevent unreasonable fishing gear conflicts. Lessees and grantees shall minimize conflict with commercial fishing activity and gear by notifying registered fishermen of the location and time frame of project construction activities well in advance of mobilization with updates throughout the construction period.
Lessees and grantees shall use practices and operating procedures that reduce the likelihood of vessel accidents and fuel spills.
Lessees and grantees shall avoid or minimize impacts on the commercial fishing industry by marking applicable structures (e.g., wind turbines, wave generation structures) with USCG approved measures (such as lighting) to ensure safe vessel operation.
Lessees and grantees shall avoid or minimize impacts on the commercial fishing industry by burying cables, where practicable, to avoid conflict with fishing vessels and gear operation. If cables are buried, lessees and grantees shall inspect cable burial depth periodically during project operation to ensure that adequate coverage is maintained to avoid interference with fishing gear/activity.
Coastal Habitats
Lessees and grantees shall avoid hard-bottom habitats, including seagrass communities and kelp beds, where practicable, and restore any damage to these communities.
Lessees and grantees shall implement turbidity reduction measures to minimize impacts on hard-bottom habitats, including seagrass communities and kelp beds, from construction activities.
Lessees and grantees shall minimize impacts on seagrass and kelp beds by restricting vessel traffic to established traffic routes.
Lessees and grantees shall minimize impacts on wetlands by maintaining buffers around wetlands, implementing BMPs for erosion and sediment control, and maintaining natural surface drainage patterns.
Electromagnetic Fields
Lessees and grantees shall use submarine cables that have proper electrical shielding and bury the cables in the seafloor where practicable.
Transportation and Vessel Traffic
Lessees and grantees shall site alternative energy facilities to avoid unreasonable interference with major ports and USCG-designated Traffic Separation Schemes.
Lessees and grantees shall meet FAA guidelines for siting and lighting of facilities.
Lessees and grantees shall place proper lighting and signage on applicable alternative energy structures to aid navigation per USCG circular NVIC 01-19 (USCG 2020) and comply with any other applicable USCG requirements.
Lessees and grantees shall conduct all necessary studies of potential interference of proposed wind turbine generators with commercial air traffic control radar systems, national defense radar systems, and weather radar systems, including identification of possible solutions.
Visual Resources
Lessees and grantees for wind projects shall address key design elements including visual uniformity, use of tubular towers, and proportion and color of turbines.
Lessees and grantees for wind projects shall use appropriate viewshed mapping, photographic and virtual simulations, computer simulation, and field inventory techniques to determine with reasonable accuracy the visibility of the proposed project. Simulations should illustrate sensitive and scenic viewpoints.
Lessees and grantees shall comply with FAA and USCG requirements for lighting while minimizing the impacts through appropriate application.
Lessees and grantees shall seek public input in evaluating the visual site design elements of proposed wind energy facilities.
Lessees and grantees, within FAA guidelines, shall use directional aviation lights that minimize visibility from shore.
Cultural Resources
Lessees and grantees shall conduct magnetometer tows using 100-feet (30-meter) line spacing in areas where there is a high potential for shipwrecks.

Source: Adopted from MMS 2007b

BMP = best management practice; BOEM = Bureau of Ocean Energy Management; FAA = Federal Aviation Administration; NMFS = National Marine Fisheries Service; USCG = U.S. Coast Guard

Table A-6: Anticipated Construction Schedule in Number of Foundations [a]

Project/Region	Before 2020	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 & Beyond
Maine Aqua Ventus (state waters)				2 [b]								
Block Island Wind Farm (state waters)	5 [b]											
Massachusetts/Rhode Island Region												
Vineyard Wind 1 (Proposed Action) part of OCS-A 0501			102									
South Fork, part of OCS-A 0517			16									
Revolution, part of OCS-A 0486				90								
Sunrise, parts of OCS-A 0500 and OCS-A 0487				112								
Mayflower (North), part of OCS-A 0521					103							
Vineyard Wind South OCS-A 0501 remainder (Park City Wind)					103							
Future Project(s) in Massachusetts/Rhode Island Region						139						
Future Project(s) in Massachusetts/Rhode Island Region							139					
Future Project(s) in Massachusetts/Rhode Island Region							172					
Estimated Annual Massachusetts/Rhode Island Construction:	*0*	*0*	*118*	*202*	*206*	*139*	*311*	*0*	*0*	*0*	*0*	*0*
Estimated Operations and Maintenance Cumulative Total:	*0*	*0*	*0*	*118*	*320*	*526*	*665*	*976*	*976*	*976*	*976*	*976*
New York/New Jersey Region												
Ocean Wind, part of OCS-A 0498				94								
Empire Wind, part of OCS-A 0512					70							
Empire Wind Phase 2, part of OCS-A 0512						70						
Empire Wind Phase 3, part of OCS-A 0512							70					
Future Project(s) in New York/New Jersey Region								131				
New Jersey-Delaware/Maryland												69
Estimated Annual New York/New Jersey Construction:	*0*	*0*	*0*	*94*	*70*	*70*	*70*	*131*	*0*	*0*	*0*	*69*
Estimated Operations and Maintenance Cumulative Total:	*0*	*0*	*0*	*0*	*94*	*164*	*234*	*304*	*435*	*435*	*435*	*504*
Delaware/Maryland Region												
Skipjack, part of OCS-A 0519				11								
US Wind, part of OCS-A 0490				24								
Future Project(s) in Delaware/Maryland Region					55							
Future Project(s) in Delaware/Maryland Region						54						
Future Project(s) in Delaware/Maryland Region							54					
Estimated Annual Delaware/Maryland Construction:	*0*	*0*	*0*	*35*	*55*	*54*	*54*	*0*	*0*	*0*	*0*	*0*
Estimated Operations and Maintenance Cumulative Total:	*0*	*0*	*0*	*0*	*35*	*90*	*144*	*198*	*198*	*198*	*198*	*198*
Virginia Region												
Coastal Virginia Offshore Wind, OCS-A 0497		2										
Dominion Commercial lease, OCS-A 0483					75							
Dominion Commercial lease, OCS-A 0483						75						
Dominion Commercial lease, OCS-A 0483							75					
Avangrid Renewables, OCS-A 0508												155
Estimated Annual Virginia Construction:	*0*	*2*	*0*	*0*	*75*	*75*	*75*	*0*	*0*	*0*	*0*	*155*
Estimated Operations and Maintenance Cumulative Total:	*0*	*0*	*2*	*2*	*2*	*77*	*152*	*227*	*227*	*227*	*227*	*382*
Estimated Annual Total Construction:	5	2	118	333	406	338	510	131	0	0	0	224
Estimated Maximum Concurrent Construction:	0	1	2	6	5	4	5	1	0	0	0	2
Estimated Operations and Maintenance Cumulative Total:	5	0	2	129	458	864	1,202	1,712	1,843	1,843	1,843	2,067

[a] Construction schedule for projects are assumed to occur over a 2-year period and for this cumulative analysis it has been assumed that pile driving would occur during year 1 of construction and all other construction activities would occur in year 2.
[b] The foundations are located in state waters.

Assumptions: All announced projects would begin construction on schedule and adequate vessels and components would be available for all projects. Construction of a project is assumed to occur over two calendar years, unless explicitly planned otherwise. Projects with more than 50 foundations are assumed to potentially utilize two pile hammers, and development without an associated project is assumed to have a pile hammer for every 50 foundations. Future Massachusetts procurements are assumed to occur in approximately 800 megawatt (MW) increments. The remaining Connecticut demand is assumed to be procured in a single 1,200 MW procurement, but could just as likely occur in two (approximately 800 MW and 400 MW) procurements and thus the timing of the associated development be staggered. Empire Wind has submitted two possible construction schedules: one depicted above was chosen due to it having the longer extent of the two proposed schedules and potentially overlapping with more projects. Empire Wind also may use gravity foundations; however, for the purposes of analyzing the maximum impact scenario it has been assumed that the foundations would be pile driven (monopile). For future development with either no associated COP or broad project envelopes, 12 MW turbine sizes were assumed for the purposes of estimating the number foundations. This is a high estimate based on the largest commercially available turbine at this time, as it is likely that the total number of foundations for projects developed in 2024 and beyond would be less as larger sized turbines become available. The development considered here does not include approximately 3,200 MW of New Jersey's goals and 6,674 MW of New York’s goals for which there is seemingly not capacity for in existing leases in the New York/New Jersey and Delaware/Maryland areas given the assumptions of 12 MW turbines spaced 1 nautical mile apart. BOEM has assumed for this SEIS cumulative analysis that either Phase 2 or 3 of Empire Wind will be “Boardwalk Wind” serving New Jersey, with the remaining phase going to either New York or New Jersey. Precisely which state gets what in terms of Empire Wind phases or development in the New Jersey leases is not consequential, as state demand will exceed space available even when including the remaining lease area around the Ocean Wind lease, the Atlantic Shores project, and full development of the remaining Delaware/Maryland lease areas being applied to New Jersey. BOEM notes that it is possible New York may continue to procure from the Massachusetts/Rhode Island leases.

A.5. PORT UPGRADES

Ports in Connecticut, Rhode Island, Massachusetts and New York may require upgrades to support the offshore wind industry developing in the northeastern United States.[4] Upgrades may include onshore developments or underwater improvements (such as dredging). The following summarizes reasonably foreseeable activities at regional ports that are planned to support the proposed Project and other past, present, and reasonably foreseeable offshore wind project activities at ports near the RI and MA Lease Areas:

- The Connecticut Port Authority announced a $93 million public-private partnership to upgrade the Connecticut State Pier in New London to support the offshore wind industry (Sheridan 2019). According to the Connecticut Maritime Strategy 2018 (Connecticut Port Authority 2018), New London is the only major port between New York and Maine that does not have vertical obstruction and offshore barriers, two factors that are critical for offshore wind turbine assembly. The document includes strategic objectives to manage and redevelop the Connecticut State Pier partially to support the offshore wind industry, which could create a dramatic increase in demand for the Connecticut State Pier and regional job growth. The development partnership, announced in May 2019, includes a 3-year plan to upgrade infrastructure to meet heavy-lift requirements of Ørsted and Eversource offshore wind components (Cooper 2019). Redevelopment of the Connecticut State Pier is considered a reasonably foreseeable activity.
- In Rhode Island, Deepwater Wind has committed to investing approximately $40 million in improvements at the Port of Providence, the Port of Davisville at Quonset Point, and possibly other Rhode Island ports for the Revolution Wind Project (Kuffner 2018). This investment will position Rhode Island ports to participate in construction and operation of future offshore wind projects in the region (Rhode Island Governor's Office 2018). The Port of Davisville has added a 150-megaton mobile harbor crane, which will enable the port to handle wind turbines and heavy equipment, and enables the Port of Davisville to participate in regional offshore wind projects (Port of Davisville 2017). Further improvements at Rhode Island ports to support the offshore wind industry are considered reasonably foreseeable.
- The Massachusetts Clean Energy Center (MassCEC) has identified 18 waterfront sites in Massachusetts that may be available and suitable for use by the offshore wind industry. Potential activities at these sites include manufacturing of offshore wind transmission cables, manufacture and assembly of turbine components, substation manufacturing and assembly, operations and maintenance bases, and storage of turbine components. The 18 sites include two identified by Vineyard Wind as potential construction or operations and maintenance ports: the Brayton Point Power Plant site and the Montaup Power Plant site.
  - The former Brayton Point Power Plant is currently being redeveloped as the Brayton Point Commerce Center, a "world-class logistical port and support center built for offshore wind…capable of component manufacturing, staging, operations, and maintenance for offshore wind and other related sectors" (Brayton Point Commerce Center 2019). The site redevelopment includes the proposed Anbaric Renewable Energy Center, which will include development of a 1,200-MW high-voltage direct current converter and 400 MW of battery storage on the site (Anbaric 2019a). Development of the Brayton Point Commerce Center and the Anbaric Renewable Energy Center are considered reasonably foreseeable, as the projects are currently active.
  - The Montaup Power Plant site is a former power plant site located in Somerset, Massachusetts, that was also identified by the MassCEC as having potential to support construction of turbine components, and for operations and maintenance activities (MassCEC 2017). No plan for redevelopment of the Montaup Power Plant has been released (MassCEC 2017); therefore, improvements at this site are not considered reasonably foreseeable.
- The MassCEC manages the New Bedford Marine Commerce Terminal in New Bedford, Massachusetts. The 29-acre facility was completed in 2015 and is the first in North America designed specifically to support the construction, assembly, and deployment of offshore wind projects (MassCEC 2018). The New Bedford Port Authority Strategic Plan 2018–2023 contains goals related to expanding the New Bedford Marine Commerce Terminal to improve and expand services to the offshore wind industry, including development of North Terminal with the capacity to handle two separate offshore wind installation projects in the future (Port of New Bedford 2018). Vineyard Wind signed an 18-month lease with the Marine Commerce Terminal in October 2018 (Port of New Bedford 2020) and has supported the New Bedford Port Authority with grants to develop publicly owned facilities to support shore-based operations for offshore wind facilities (Vineyard Wind 2019).
- Vineyard Wind would use Vineyard Haven Harbor in Tisbury as the location of the proposed Project's Operations and Maintenance Facility. Vineyard Haven Harbor is the island's year-round working port and is home to most of the Martha's Vineyard boatyards. Small coastal tankers and ferries regularly use Vineyard Haven Harbor to transport freight, vehicles, and passengers. The areas of Tisbury near the Vineyard Haven Harbor are a mix of marine-related, commercial, and residential uses. Vineyard Wind has stated that upgrades to the port are not as a direct result of the proposed Project; therefore, any impacts from potential upgrades to this port would not be a result of the proposed Project.

[4] BOEM 2016c includes an assessment of port capacity, potential environmental and socioeconomic consequences of port modifications to support offshore wind development, and the effectiveness of potential mitigation measures to reduce said consequences of port modifications.

Potential impacts related to port upgrades could include, but are not limited to, the following:

- Increased seafloor disturbance, turbidity, and benthic habitat alterations;
- Risk of direct physical impacts, displacement, or disturbance to wildlife, including threatened/endangered species;
- Increased vessel traffic and associated effluent discharges, air emissions, and noise;
- Visual impacts on onshore and offshore observers within the daytime and nighttime visibility zones;
- Economic impacts, including beneficial impacts on tax revenues, employment, and economic activity associated with operating the wind energy facility, maintaining the wind energy facility, tourism, and other ocean economy sectors;
- Displacement or reduction in fishing opportunities (commercial and recreational), marine mineral extraction, and other ocean economy sectors;
- Displacement of recreational opportunities or change in value of recreational opportunities;
- Disturbance of cultural resources or impacts on cultural values; and
- Introduction of navigational obstructions to aviation and marine vessels (submarine and surface vessels).

A.6. Offshore Export Cables Construction and Maintenance

Offshore cable routes have been identified for the Coastal Virginia Offshore Wind Project (Dominion Energy 2018) and the seven COPS that have been submitted. Cable routes have not yet been announced for the remainder of the projects.

In addition, Anbaric Development Partners, LLC has submitted unsolicited proposals to BOEM for development of two open access offshore transmission systems, designed to support offshore wind in the northeastern United States; however, neither are considered reasonably foreseeable projects for this analysis:

- The proposed New York/New Jersey Ocean Grid Project would consist of approximately 185 nautical miles (213 statute miles) of subsea transmission cables, and up to nine offshore collector platforms. The transmission network would collect and distribute power from wind lease areas offshore New York and New Jersey to up to six onshore landing locations from Long Island to Cardiff, New Jersey (Anbaric 2018).
- The proposed Southern New England OceanGrid Project would consist of 337 nautical miles (388 statute miles) of subsea transmission cables and up to eight offshore collector platforms around the RI and MA Lease Areas. The transmission network would collect and distribute power generated from RI and MA Lease Areas offshore wind farms to landings between Long Island Sound and Massachusetts (Anbaric 2019b).

The transmission systems would be “open access” and allow multiple offshore wind farms to connect to a single transmission line, potentially consolidating cabling systems, landing areas, and onshore infrastructure. Utilizing a transmission network may reduce total miles of cables required to connect offshore wind farms, environmental impacts associated with subsea cabling and onshore interconnections, and costs of development and operation. BOEM issued a Request for Competitive Interest for the New York/New Jersey Ocean Grid Project in June 2019. These projects are currently under review with BOEM and are not considered reasonably foreseeable due to the current lack concrete development plans. Even if BOEM did consider these projects reasonably foreseeable, they would not be considered in the maximum impact scenario because implementation of these networks would serve to reduce impacts associated with the transmission system. The maximum impact scenario for offshore cables associated with offshore wind development is defined as each lease having separate offshore cables, landing sites, and onshore interconnection facilities.

Reasonably foreseeable impacts of new transmission system projects associated with individual offshore wind projects could include (BOEM 2016b):

- Increased vessel traffic and associated effluent discharges, air emissions, and noise during construction and decommissioning;
- Increases of accidental releases of trash and marine debris during construction and decommissioning;
- Intermittent underwater noise associated with construction, including noise from ESP construction activities;
- Temporary disturbance of benthic habitat from installation, and long-term impacts from habitat conversion;
- Increased potential for oil spills during construction and decommissioning;
- Potential interaction with existing telecommunication cables; and
- Temporary sediment disturbance during installation or maintenance.

A.7. Geographic Analysis Area Maps

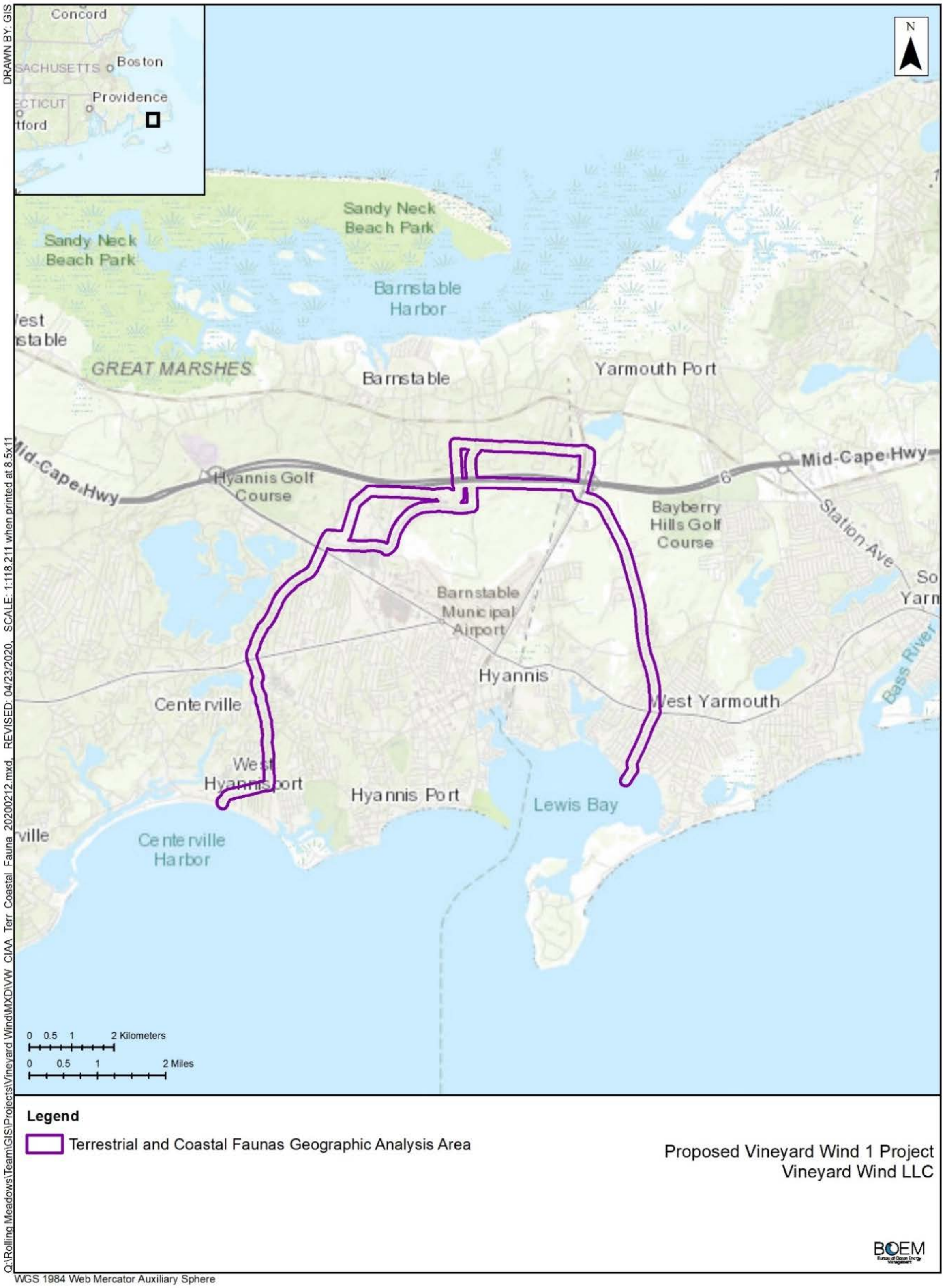


Figure A.7-1: Terrestrial and Coastal Faunas Geographic Analysis Area

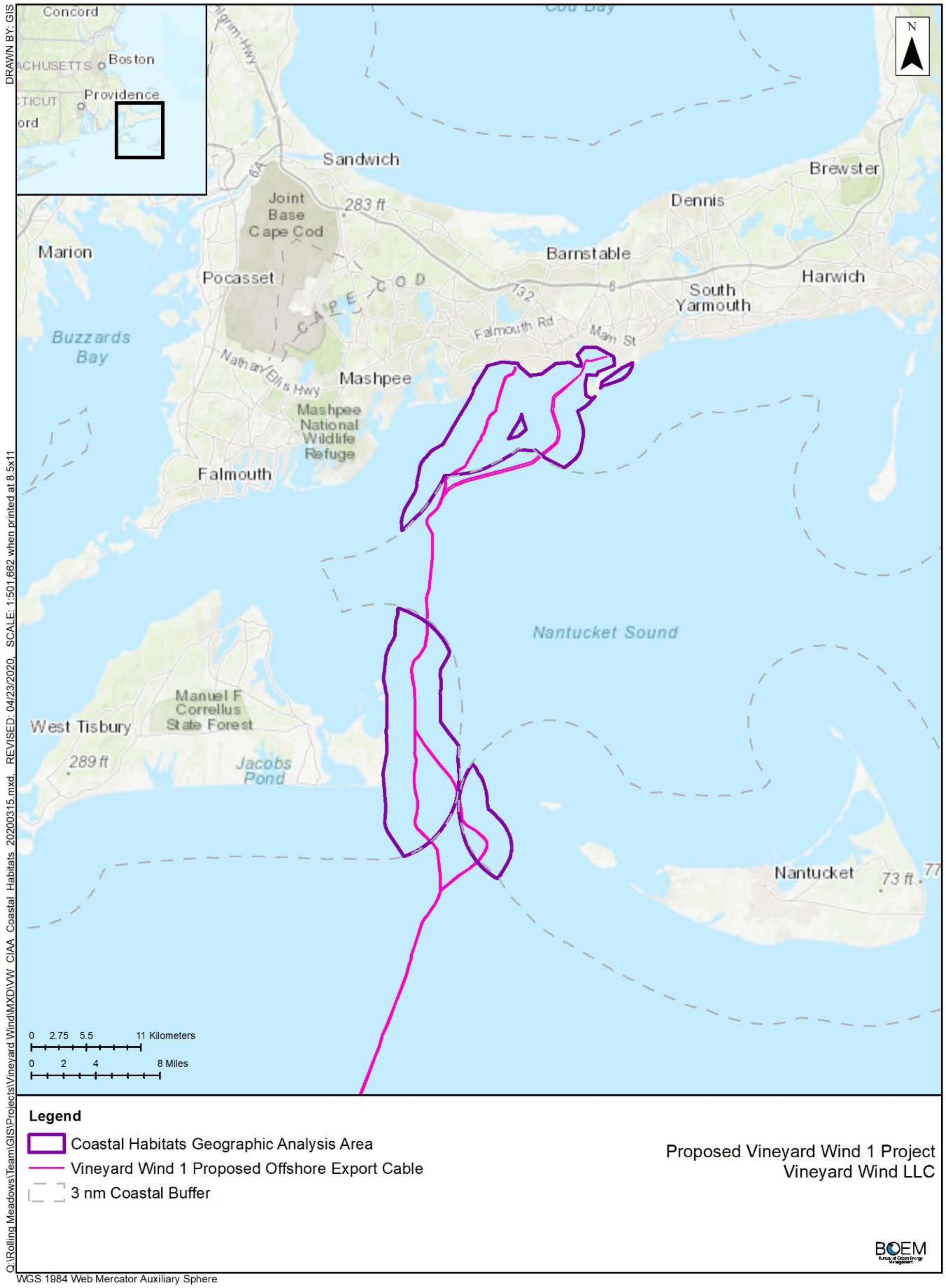


Figure A.7-2: Coastal Habitats Geographic Analysis Area

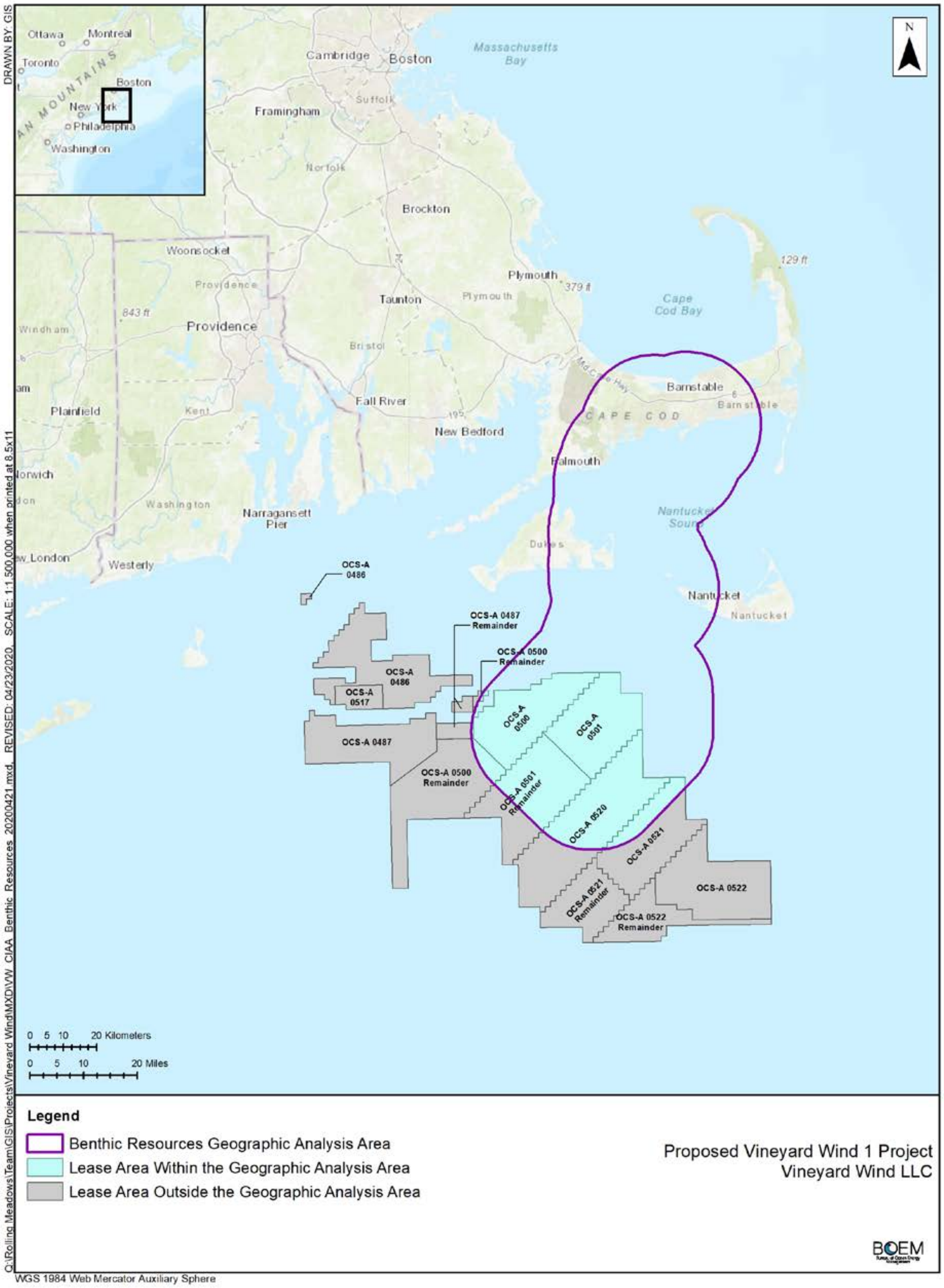
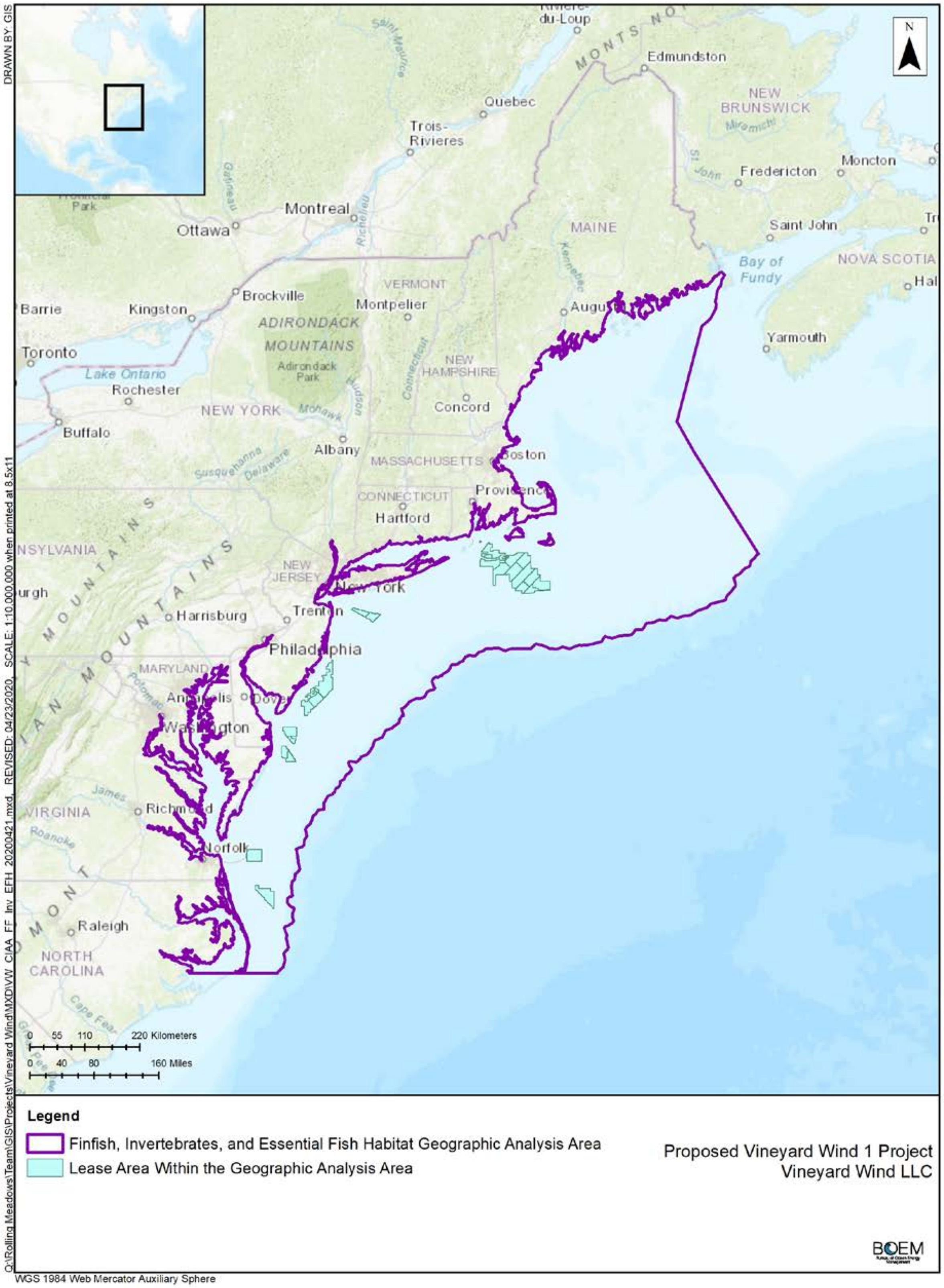


Figure A.7-3: Benthic Geographic Analysis Area



Note: The geographic analysis area for the endangered Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*) extends beyond the boundary shown here and is equivalent to the area shown in Figure A.7-5.

Figure A.7-4: Finfish, Invertebrates, and Essential Fish Habitat Geographic Analysis Area

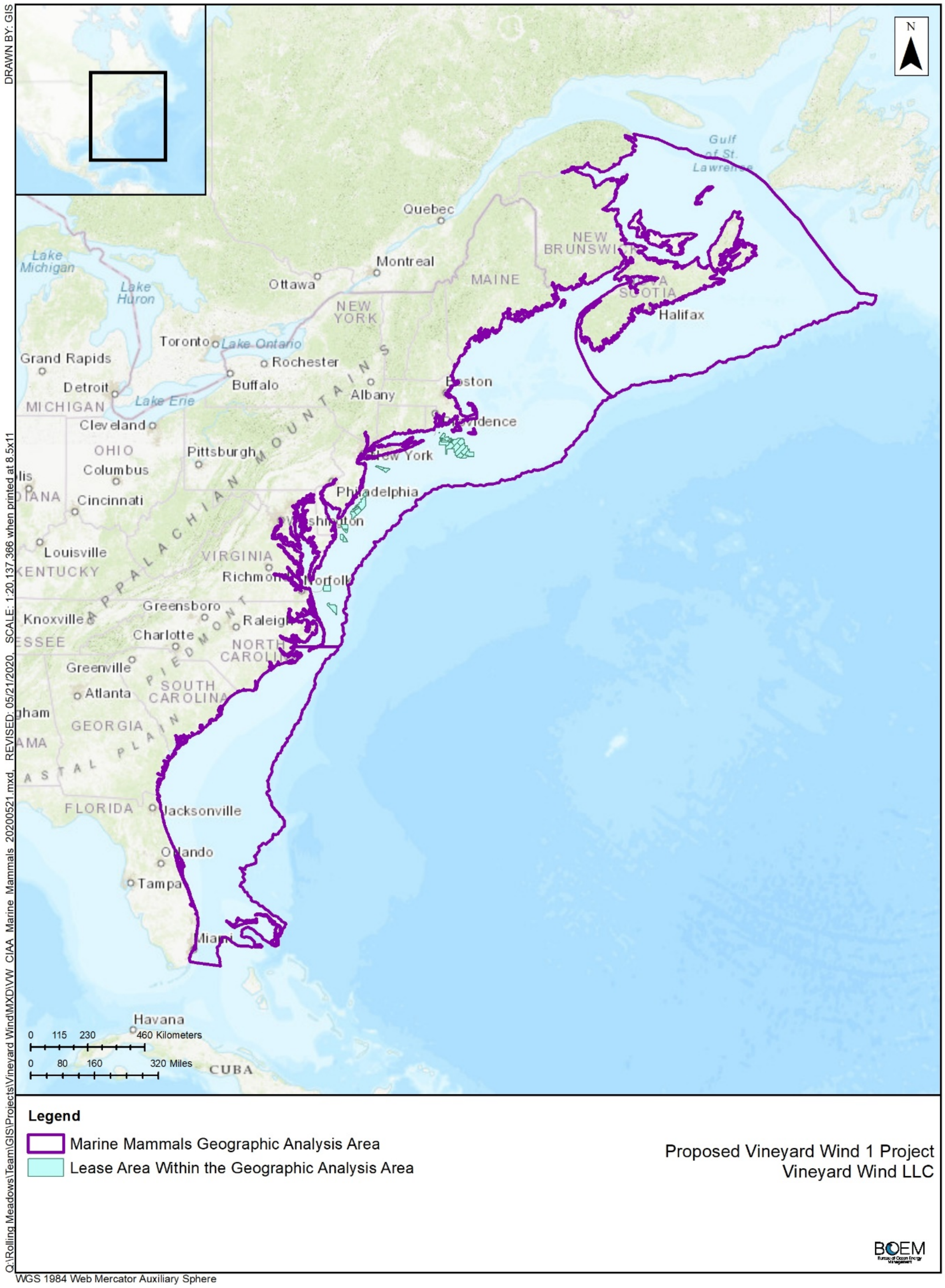


Figure A.7-5: Marine Mammals Geographic Analysis Area

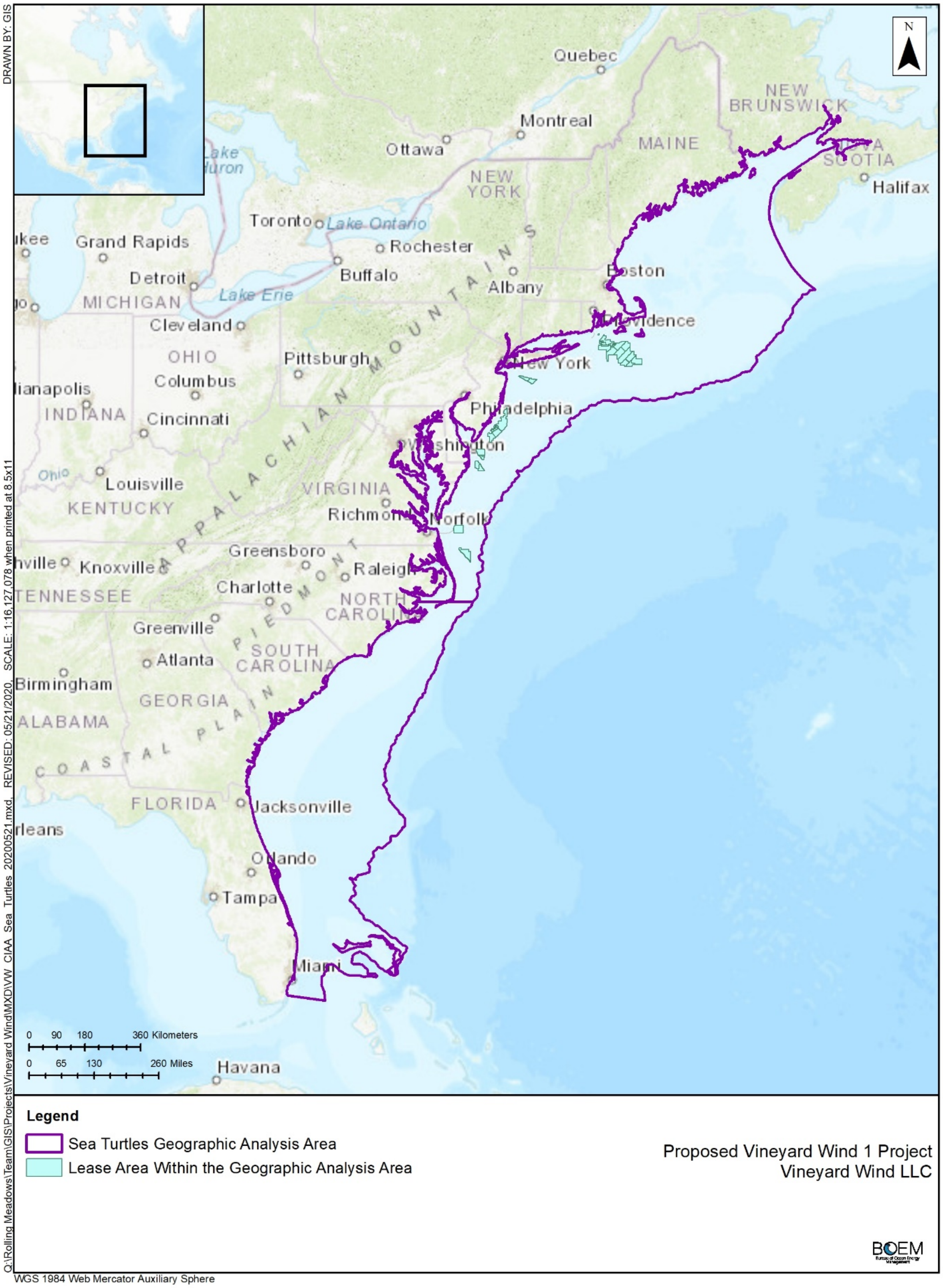


Figure A.7-6: Sea Turtles Geographic Analysis Area

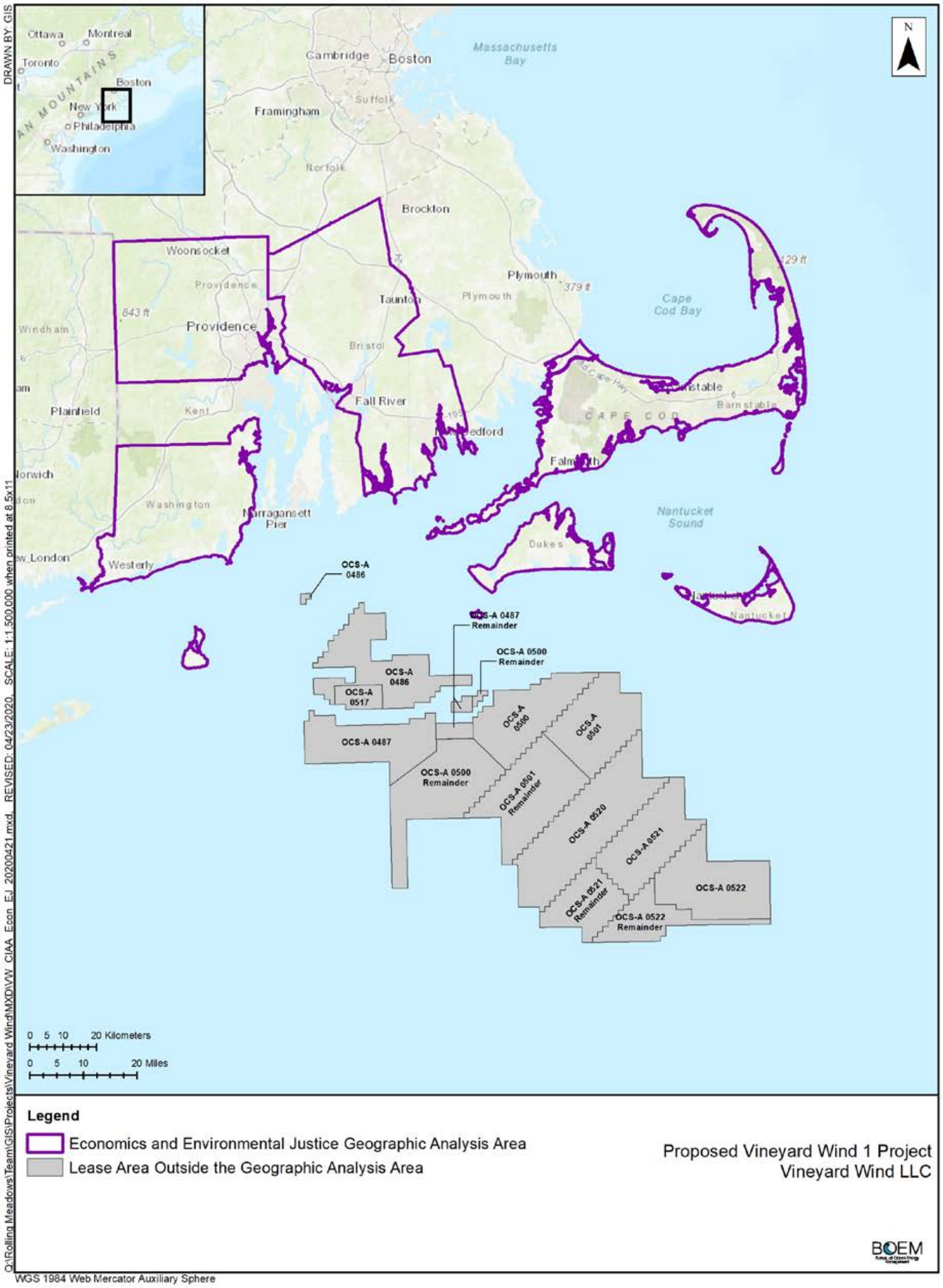


Figure A.7-7: Economics and Environmental Justice Geographic Analysis Area

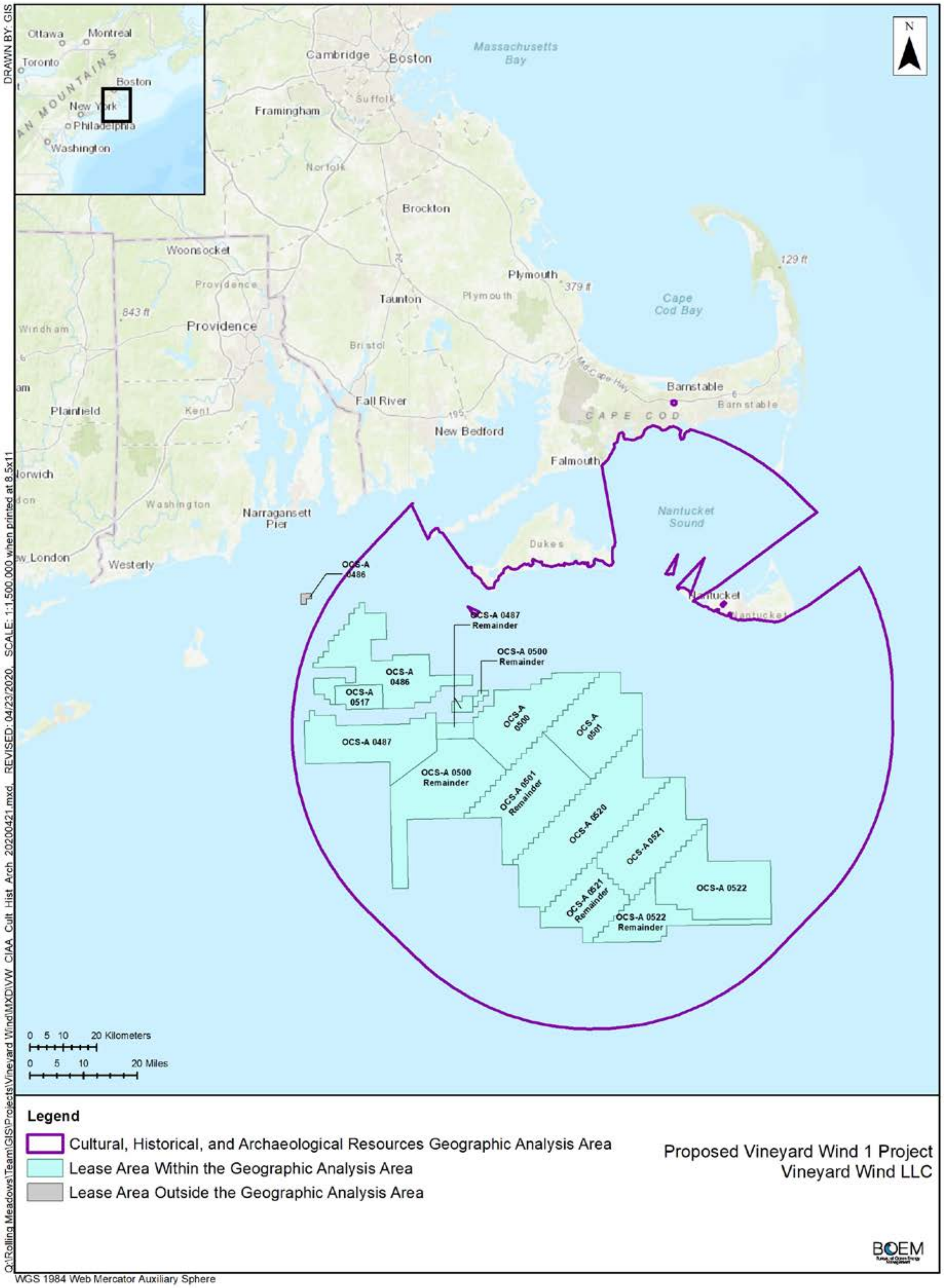


Figure A.7-8: Cultural, Historical, and Archaeological Resources Geographic Analysis Area

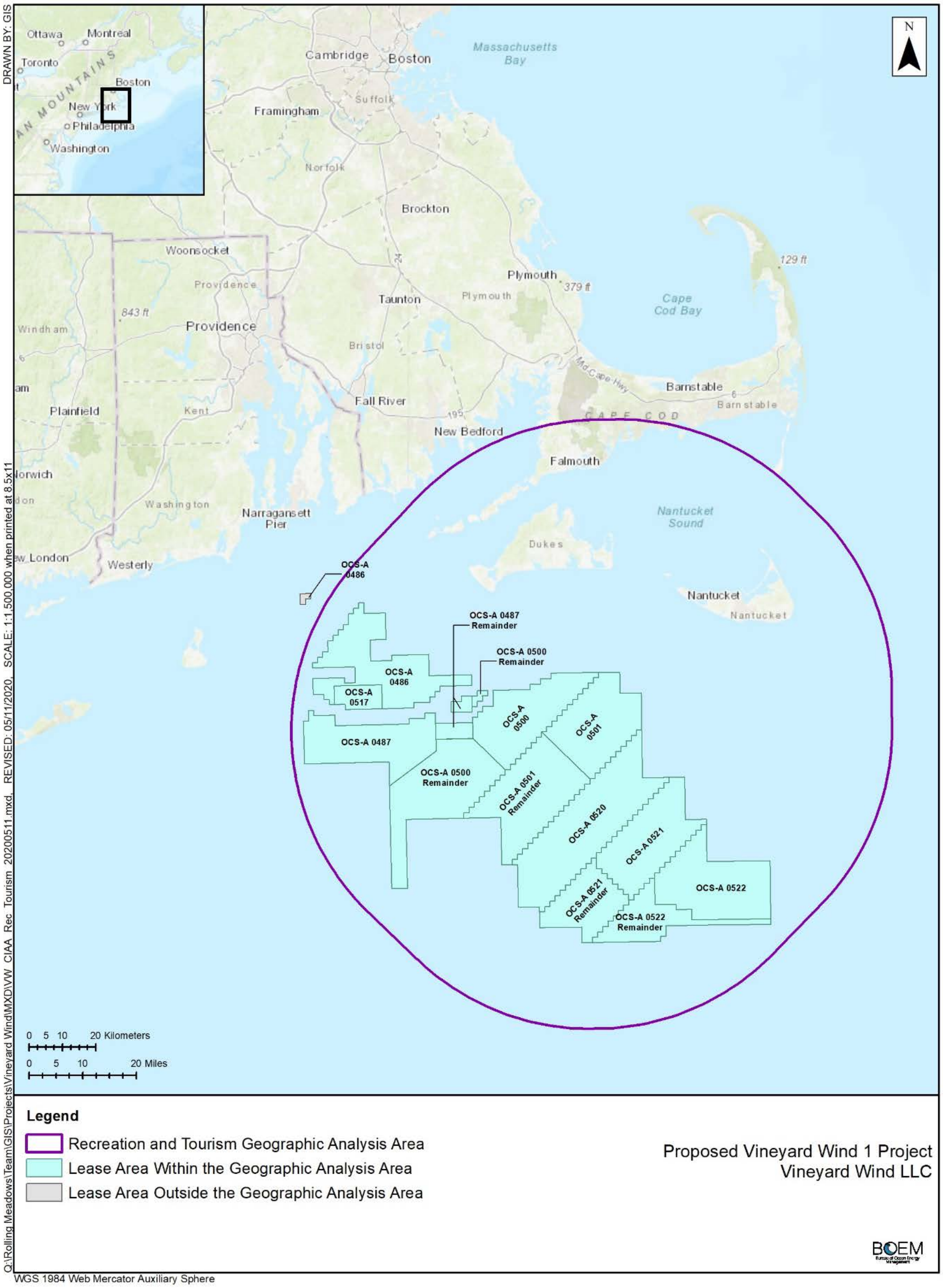


Figure A.7-9: Recreation and Tourism Geographic Analysis Area

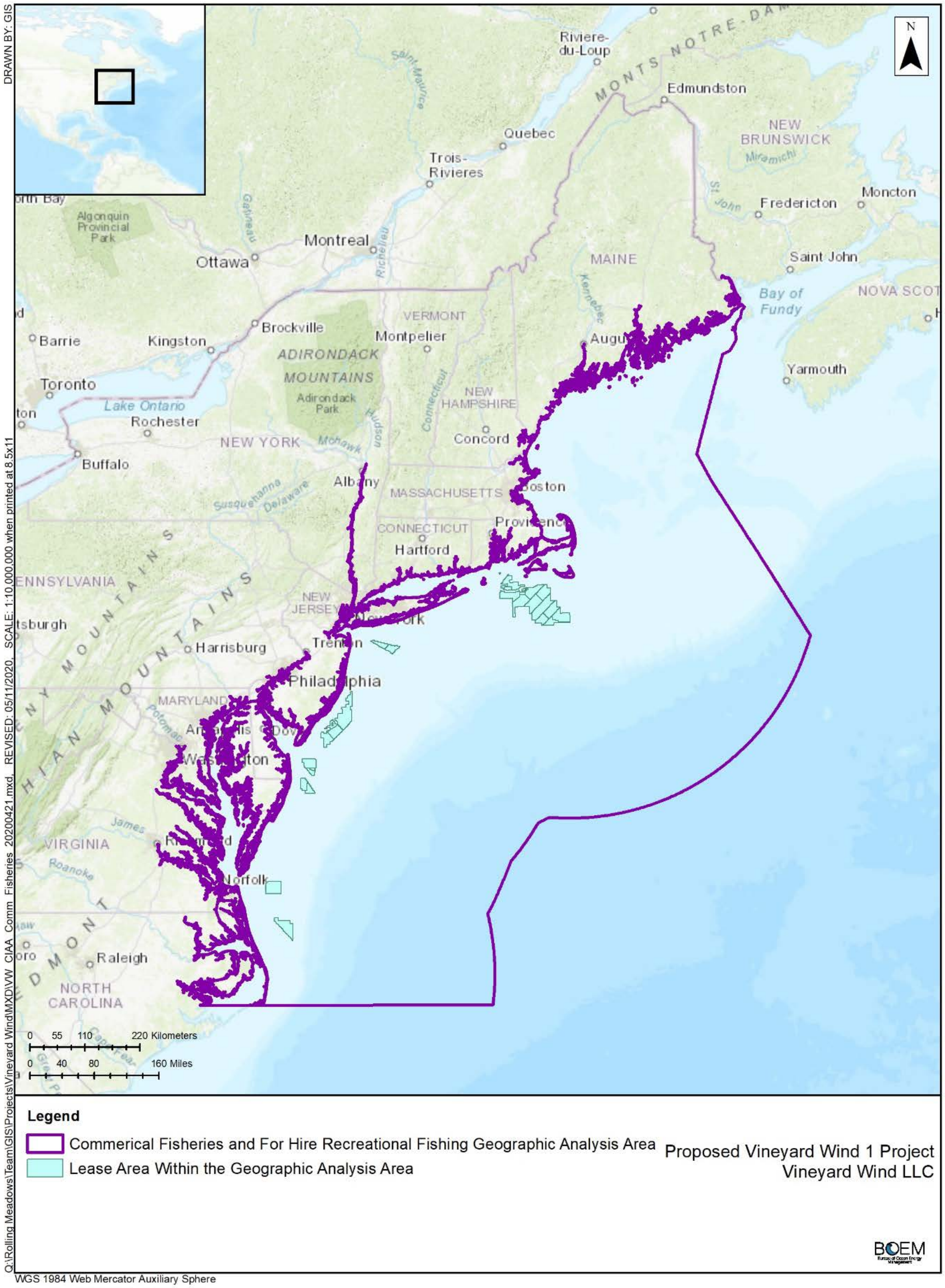


Figure A.7-10: Commercial Fisheries and For Hire Recreational Fishing Geographic Analysis Area

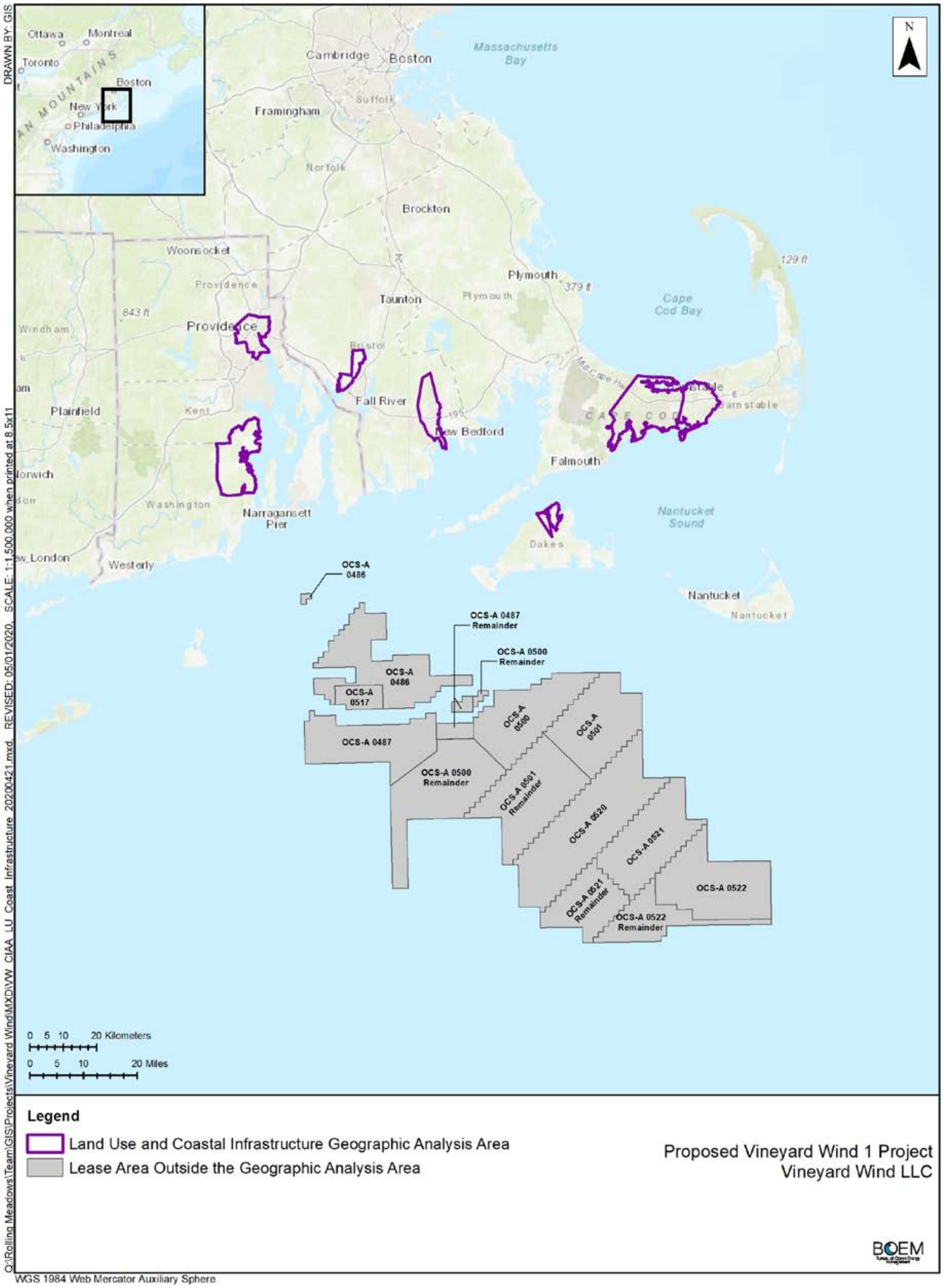


Figure A.7-11: Land Use and Coastal Infrastructure Geographic Analysis Area

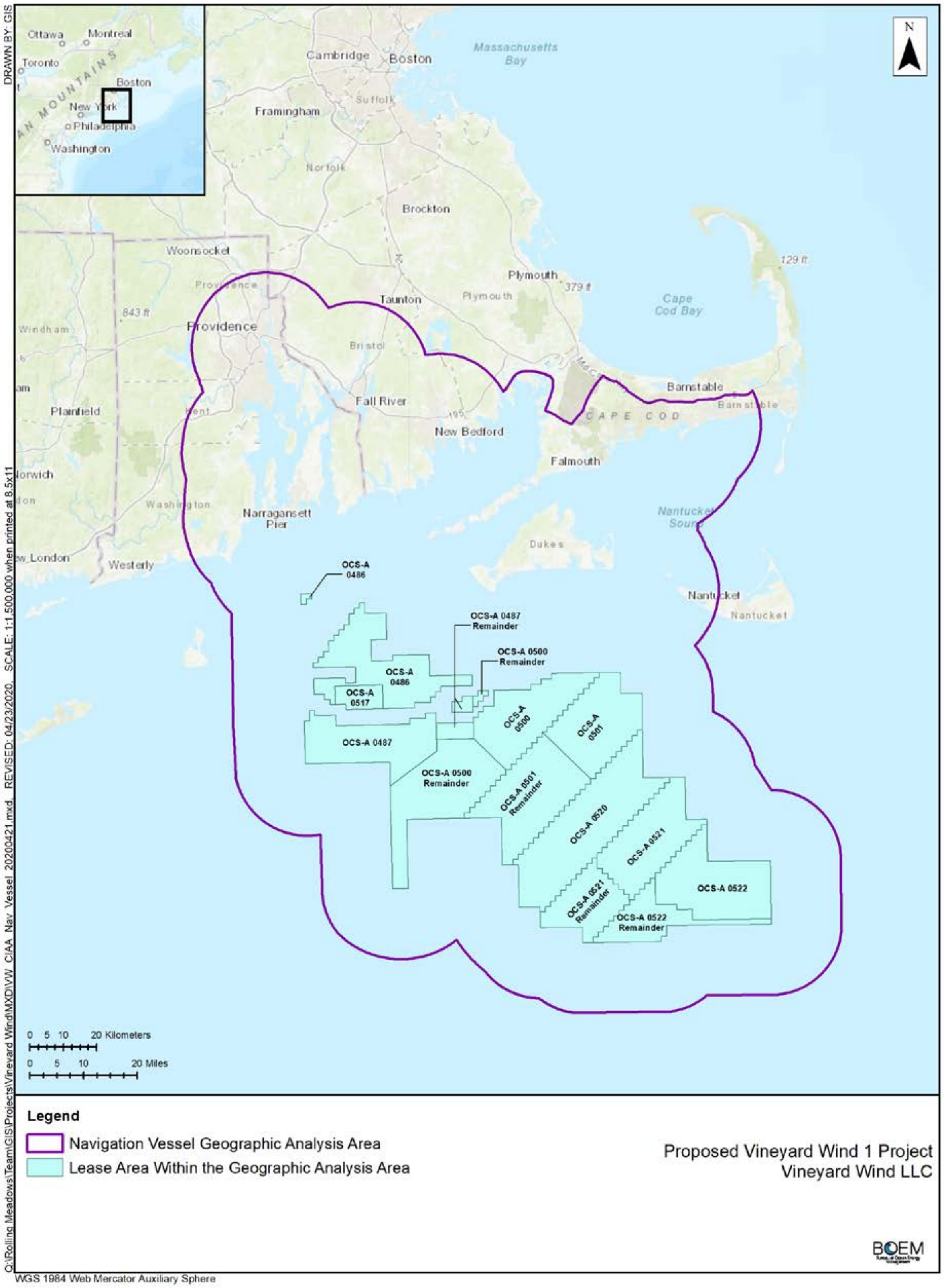


Figure A.7-12: Navigation and Vessel Traffic Geographic Analysis Area

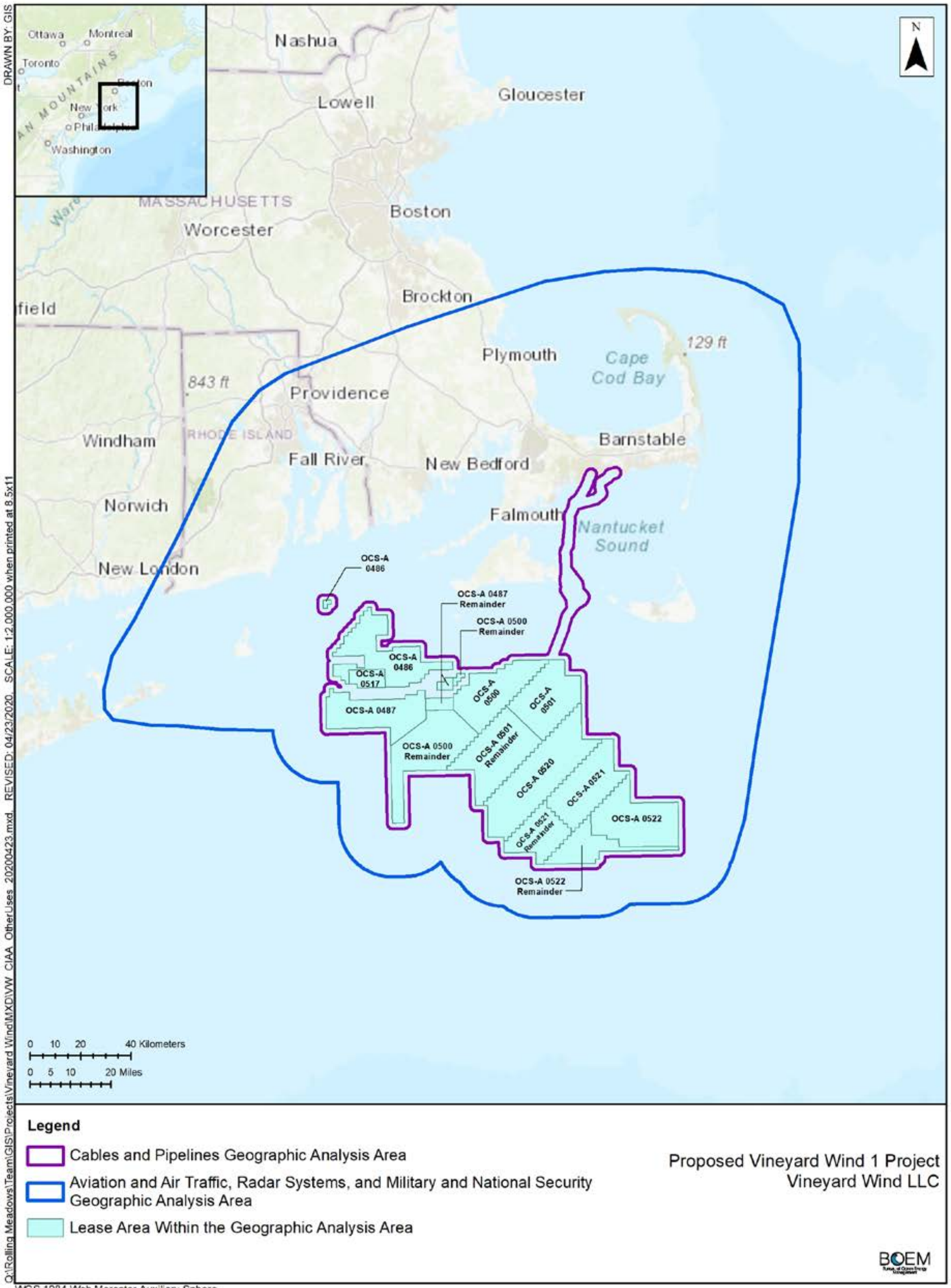


Figure A.7-13: Other Uses Geographic Analysis Area

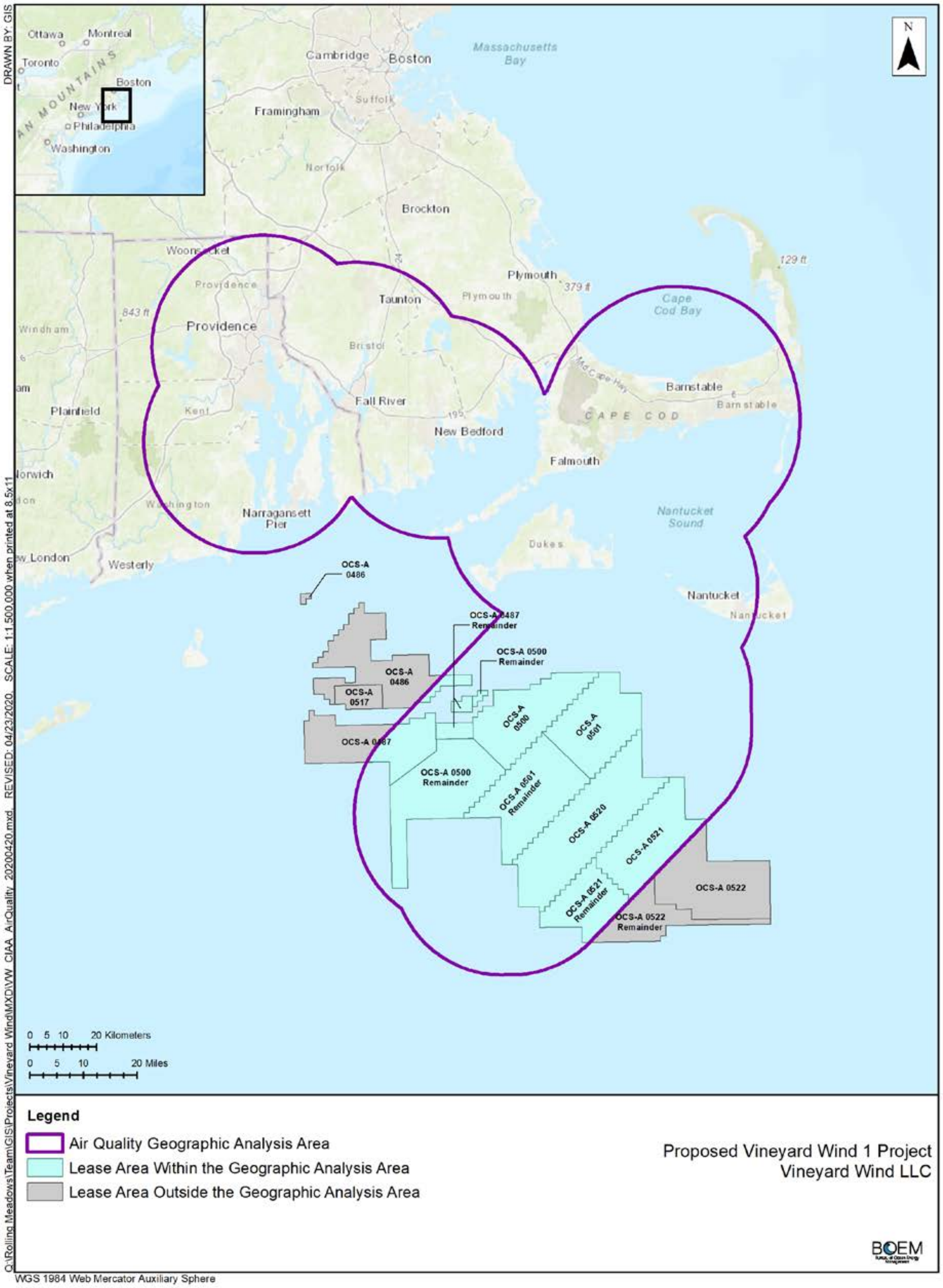


Figure A.7-14: Air Quality Geographic Analysis Area

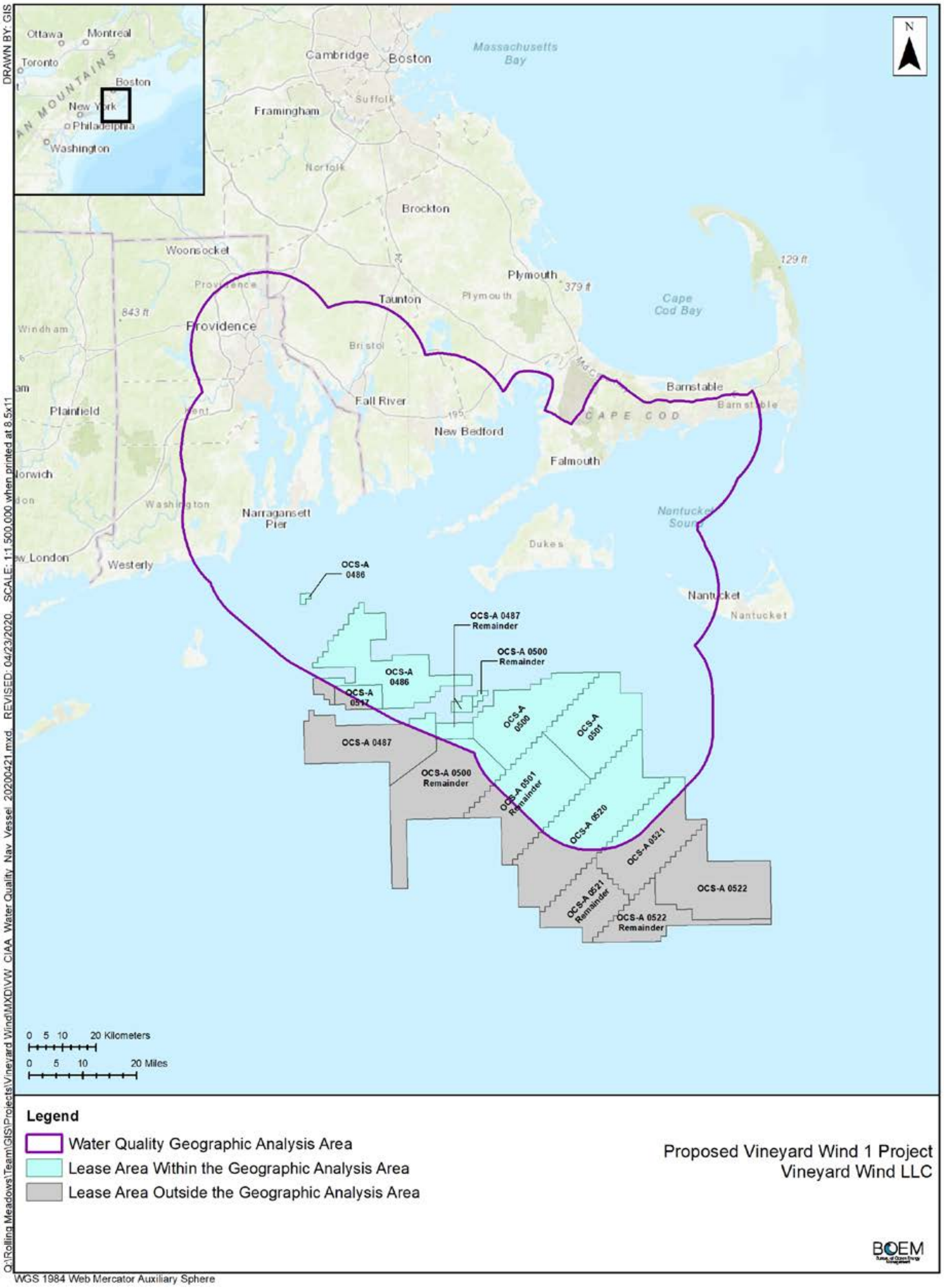


Figure A.7-15: Water Quality Geographic Analysis Area

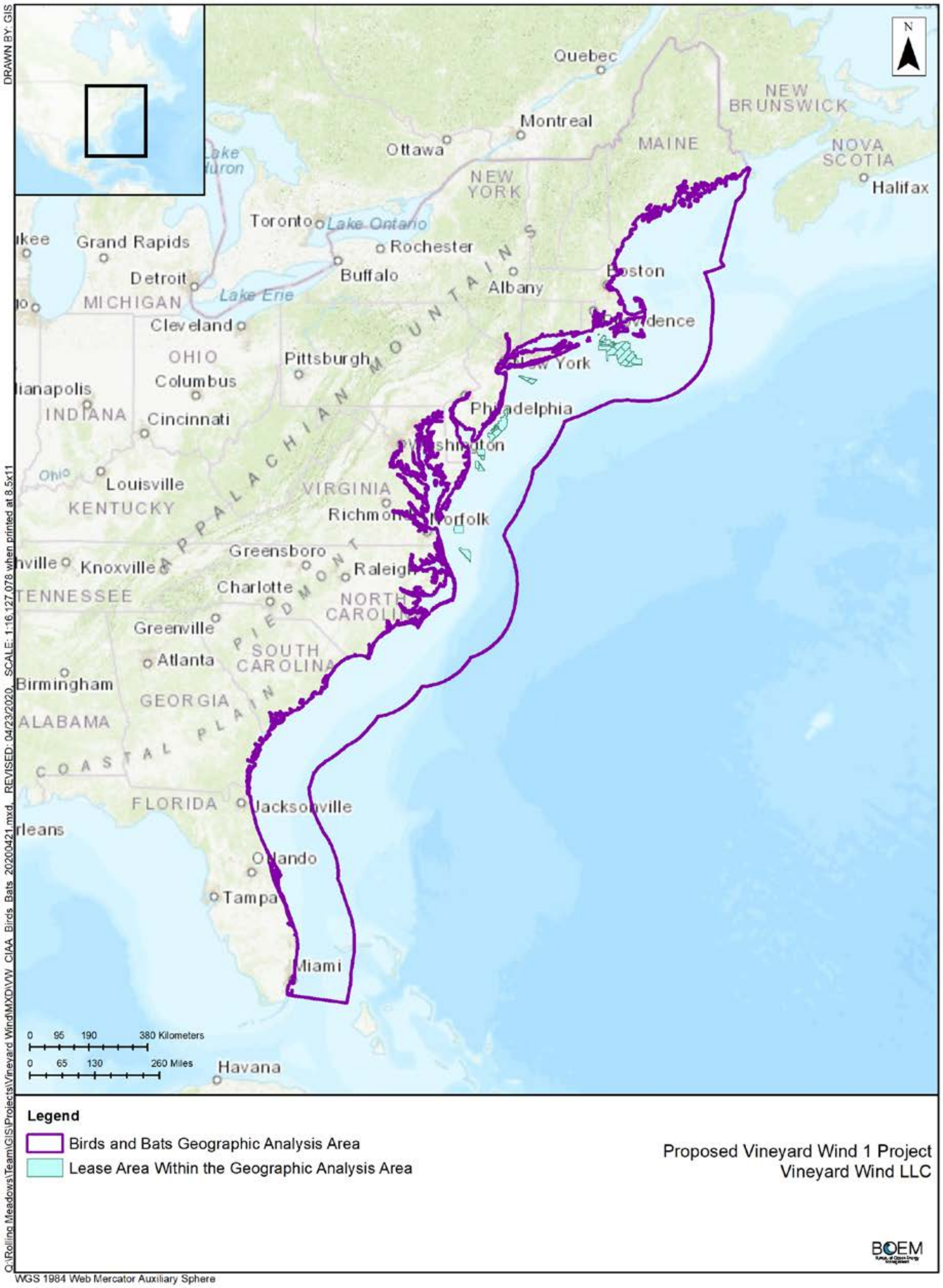
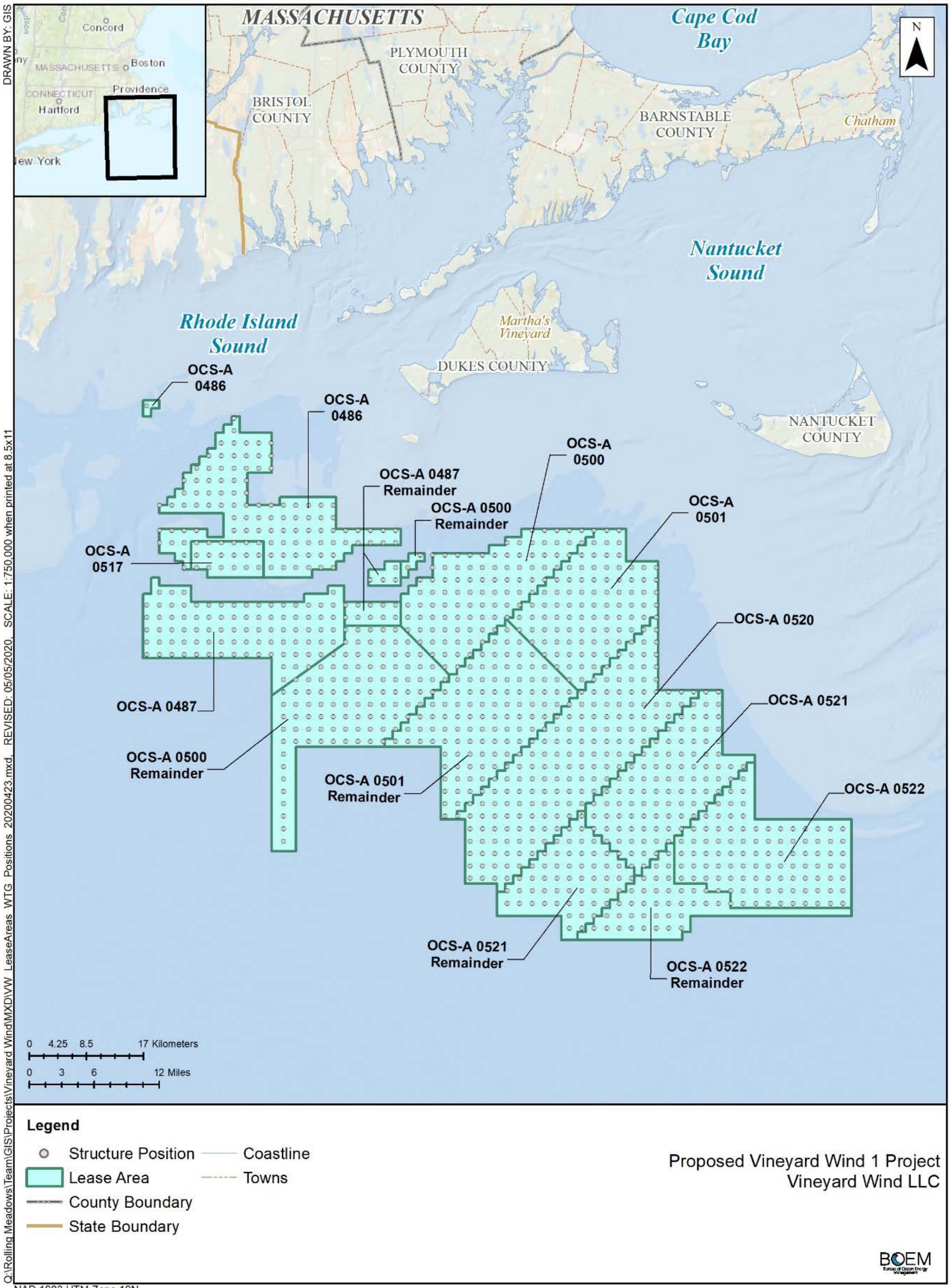


Figure A.7-16: Birds and Bats Geographic Analysis Area



Note: The layout shown is for illustrative purposes only and does not guarantee that the positions identified are buildable. The layout is based on the all developer agreement for east-west orientation and 1-nautical mile by 1-nautical mile spacing (Geijerstam et al. 2019). The positions shown do not necessarily represent future WTG locations, and these locations are not based on a specific WTG size.

Figure A.7-17: Joint Developer Agreement Layout

A.8. ASSESSMENT OF RESOURCES WITH MINOR IMPACTS

A.8.1. Air Quality

A.8.1.1. No Action Alternative Impacts

Table A-7 contains a detailed summary of baseline conditions and the impacts of ongoing and future offshore activities other than offshore wind on air quality, based on the impact-producing factors (IPFs) assessed. This information comes primarily from the Draft EIS, supplemented by information developed in responding to comments on the Draft EIS and additional information. The impact analysis is limited to impacts within the geographic analysis area for air quality as described in Table A-1 and shown on Figure A.7-14. Specifically, this includes the airshed within 15.5 miles (25 kilometers) of each area potentially impacted by the proposed Project, including the lease area, the on-land construction areas, and the mustering port(s).

Regional air quality is assessed with reference to National Ambient Air Quality Standards (NAAQS) for criteria pollutants established by the U.S. Environmental Protection Agency (USEPA) under the Clean Air Act (CAA) (42 United States Code § 7409) to protect human health and welfare. The criteria pollutants are carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter with diameters 10 microns or smaller (PM_{10}), particulate matter with diameters 2.5 microns or smaller ($PM_{2.5}$), nitrogen dioxide[5] (NO_2), ozone, and lead.

All of southeastern Massachusetts is presently designated as unclassifiable or in attainment for all criteria pollutants (Epsilon 2020), except for Dukes County on Martha's Vineyard which is designated as marginally in nonattainment for the 2008 ozone NAAQS. This designation was based on data collected at the Herring Creek Road Aquinnah monitor (Monitor #25-007-0001) from 2009 to 2011, which showed a monitored concentration of 76 parts per billion (ppb) against the 2008 NAAQS of 75 ppb. While the 2008 NAAQS are still technically in effect, Dukes County was designated in attainment in August 2018 against the more stringent 2015 ozone NAAQS of 70 ppb (80 Fed. Reg. 206 [October 26, 2015]), based on a monitored concentration of 64.3 ppb between 2014 and 2016. Thus, while the 2008 designation has not yet been changed, monitored values in Dukes County have significantly improved since 2011. Dukes County is in attainment with the 2015 ozone NAAQS standard, however its official designation is as a "marginal nonattainment area" based on the 8-hour ozone standard in 2008. Administratively, the USEPA must change this designation to attainment, but has not done so yet. The entire State of Rhode Island is currently in attainment for all criteria pollutants.

The No Action Alternative without implementation of other future offshore wind projects would likely result in increased air quality impacts regionally due to the need to construct and operate new energy generation facilities to meet future power demands. These facilities may consist of new natural gas-fired power plants, coal-fired, oil-fired, or clean coal-fired plants. As indicated by recent market and permitting trends, future electric generating units would most likely include natural gas-fired and oil-fired dual fuel facilities, and a mix of natural gas, dual fuel natural gas/oil, solar, wind, and energy storage would likely occur in the future due to market forces and state energy policies. Nonetheless, impacts from fossil fuel facilities are expected to be mitigated partially by installation of other offshore wind projects surrounding the proposed Project area, including in the region off New York and New Jersey, as described below, to the extent that these wind projects would result in a reduction in fossil fuel-type emissions from power generating facilities.

Under the No Action Alternative, the proposed Project would not be built and hence would have no air quality impact. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. The following analysis addresses reasonably foreseeable offshore wind projects (or portions of projects) that fall within the geographic analysis area and considers the assumptions included in this SEIS Section 1.2 and here in Appendix A. The analysis assumes that state offshore wind power demand could not be accommodated entirely by projects in the geographic analysis area for air quality, and the analysis does not include the impacts associated with the proposed Project. A detailed analysis of impacts associated with future offshore wind development is provided in Section A.8.1.1.1 and summarized in Table A-7. Cumulative impacts of the Proposed Action and action alternatives are analyzed in Section A.8.1.2.

A.8.1.1.1 Future Offshore Wind Activities (without Proposed Action)

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

Accidental releases: Future offshore wind activities could release air toxics or hazardous air pollutants (HAPs) because of accidental chemical spills within the air quality geographic analysis area. Section A.8.2 includes a discussion of the nature of releases anticipated. Up to about 246,069 gallons (931,473 liters) of coolants, 2,959,524 gallons (11.2 million liters) of oils and lubricants, and 494,632 gallons (1.8 million liters) of diesel fuel will be contained in the construction of 581 foundations (WTGs and ESPs) for the wind energy projects within the air quality geographic analysis area. Accidental releases are most likely during construction, but could occur during operations and decommissioning of offshore wind facilities. These may lead to short-term periods of HAP emissions through surface evaporation. Hazardous air pollutant emissions would consist of volatile organic compounds (VOC's) which may be important for ozone production. By comparison, the smallest tanker vessel operating in these waters (a general purpose tanker) has a capacity of between 3.2 and 8 million gallons (12.1 million to 30.3 million liters). As described in Draft EIS Section 3.4.7.1, tankers are relatively common in these waters, and the total WTG chemical storage capacity within the geographic analysis area for air is much less than the volume of hazardous liquids

[5] Nitrogen oxides (NOx) and NO2 emissions are proportional to each other. The NAAQS is specific to NO2, but emissions data is typically reported as NOX.

transported by ongoing activities (U.S. Energy Information Administration 2014). BOEM expects air quality impacts from accidental releases would be short-term and limited to the area nearby the accidental release location. Accidental spills would occur infrequently over a 30-year period with a higher probability of spills during future project construction, but they would not be expected to appreciably contribute to overall impacts on air quality.

Air emissions: Most air pollutant emissions and air quality impacts from future offshore wind projects would occur during construction, potentially from multiple co-occurring projects. All projects would be required to comply with the CAA. During the limited times of construction and decommissioning, emissions might exceed *de minimis* thresholds, requiring offsets and mitigation. Primary emission sources would include increased commercial vehicular traffic, air traffic, public vehicular traffic, construction equipment, and fugitive emissions leaks. As projects come online, emissions overall would decline and the projects would benefit air quality overall.

The future offshore wind projects that may result in air emissions and air quality impacts within the air quality geographic analysis area include projects located within all or portions of the following lease areas: OCS-A-0486, OCS-A-0487, OCS-A-0500, OCS-A-0501 South, OCS-A-0520, and OCS-A-0521. Based on the cumulative assumptions in Table A-4, these projects would produce 5,939 MW of renewable power from the installation of 593 foundations. Based on the assumed construction schedule presented in Table A-6, those projects within the geographic analysis area would have overlapping construction periods beginning in 2022 and continuing through 2030. During the construction phase, the total emissions of criteria pollutants (NO_2, SO_2, CO, PM_{10}, $PM_{2.5}$, and VOCs within the air quality geographic analysis area would be approximately 38,220 tons, distributed as follows: approximately 75 percent nitrogen oxides (NO_x), approximately 1 percent SO_2, approximately 17 percent CO, approximately 2 percent VOC and about 6 percent particulates. The carbon dioxide (CO_2) construction emissions make up the largest percentage of total construction-phase emissions, resulting in about 1.9 million tons of CO_2 emissions for the projects within the air quality geographic analysis area. Overall, construction and decommissioning phases would have the largest emissions. The largest emissions of criteria pollutants would be NO_X (28,840 tons) and CO (6,486 tons), most from diesel construction equipment, vessels, and commercial vehicles. The magnitude of the air emissions and the air quality impacts would vary spatially and temporally during the construction phases even for overlapping projects. This spatial and temporal variability assumes that construction activity would occur at different locations and would always overlap with activities at other locations. As a result, air quality impacts would shift spatially and temporally across the air quality geographic analysis area.

Future offshore wind projects within the air quality geographic analysis area would overlap during operations, but operations would contribute few criteria pollutant emissions compared to construction and decommissioning and would come largely from commercial vessel traffic and emergency diesel generators. Most emissions would be NO_X (412 tons per year [74 percent of the total operations criteria pollutant emissions]) and CO (105 tons per year [19 percent of the total operations criteria pollutant emissions]). The other criteria pollutants would each account for less than 3 percent of the total operations emissions. Operations air emissions would overall be short-term, intermittent, widely dispersed, and would generally contribute to small and localized air quality impacts.

CO_2 emissions comprise about 98 percent of the total operation emissions (31,898 tons per year). CO_2 is a GHG and important for assessing climate change impacts. However, it is not a criteria pollutant and is not included in air quality impact analyses. Offshore wind energy development would help offset emissions from fossil fuels, improving regional air quality and reducing GHGs. An analysis by Katzenstein and Apt (2009), for example, estimates that CO_2 emissions can be reduced by up to 80 percent and NO_X emissions can be reduced up to 50 percent by implementing wind energy projects.

Climate change: Construction and operation of offshore wind projects would produce GHG emissions (nearly all CO_2) that contribute to climate change; however, these contributions would be minuscule compared to aggregate global emissions. CO_2 is relatively stable in the atmosphere and for the most part mixed uniformly throughout the troposphere and stratosphere. Hence the impact of GHG emissions does not depend upon the source location. Increasing energy production from offshore wind projects will likely to decrease GHGs emissions by replacing energy from fossil fuels. This reduction will more than offset the very limited GHG emissions from offshore wind projects. Offshore wind projects will by themselves probably have little impact on climate change but they may be significant and beneficial as a component of many actions addressing climate change.

A.8.1.1.2 Conclusions

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impacts on air quality. BOEM expects ongoing activities and future offshore and onshore wind activities to have continuing regional air quality impacts primarily through air emissions, accidental releases, and climate change. Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in minor adverse impacts because of emissions of CO, NO_2, SO_2, particulates, and some air toxics, mostly released during construction and decommissioning. Emissions during operations would be generally lower and more transient, with emissions of NO_X and CO from combustion sources predominating. CO_2, a GHG but not a criteria pollutant, would contribute most emissions during construction and operations. Most air emissions and air quality impacts would occur during multiple overlapping project construction phases, beginning in 2022 and continuing through 2030. Overall, adverse air quality impacts from future offshore wind projects are expected to be relatively small and transient.

The proposed Project and other future offshore wind projects will in fact probably lead to reduced emissions from fossil fuel power-generating facilities and benefit air quality. Under the No Action Alternative, additional, more polluting, fossil fuel energy facilities would come or be kept on-line to meet future power demand, fired by natural gas, oil, or coal. These larger impacts would be mitigated partially by other future offshore wind projects surrounding the proposed Project area, including offshore New York and New Jersey.

A.8.1.2. Proposed Action and Action Alternatives

A.8.1.2.1 Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on air quality were described in Draft EIS Section 3.2.1.1, and additional information is included in Table A-7. The Proposed Action would probably lead to reduced emissions from fossil fuel power-generating facilities and benefit air quality. Although there would be some air quality impacts due to various activities associated with construction, maintenance, and eventual decommissioning, these emissions would be relatively small and limited in duration. BOEM could reduce potential impacts by requiring the use of fuel-efficient engines and dust control plans for onshore construction areas. The Proposed Action would contribute to impacts through all the IPFs named in Section A.8.1.1.1. The most impactful IPFs would likely include air emissions. Most impacts would likely be during construction and decommissioning because of increased emissions from vessel traffic and commercial vehicles and from both end-of-pipe and fugitive emissions during construction. Other IPFs would likely contribute impacts of lesser intensity and extent, primarily during construction and decommissioning but also during operations (Table A-7).

Changes to the design capacity of the WTGs proposed in the Vineyard Wind COP (Epsilon 2020), as compared to the WTGs evaluated in the Draft EIS, would not alter the maximum potential air quality impacts for the Proposed Action and all other action alternatives because the maximum-case scenario involved the maximum number of WTGs (100) allowed in the Project Design Envelope (PDE). In addition, the additional acreage required for the proposed onshore substation would not alter the air quality impacts for the Proposed Action and all other action alternatives.

The cumulative impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are listed by IPF in Table A-7. The nature of the primary IPFs and of potential impacts on air quality is described in detail in Section A.8.1.1.1. The cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities would be of similar types as described in Section A.8.1.1, but may differ in intensity and extent. BOEM assumes that the impacts on resources with a “restricted” geographic analysis area, such as air quality, would not be equal with or without the Proposed Action. In the absence of the Proposed Action, BOEM assumes that the total generating capacity of offshore wind facilities in the geographic analysis area would be 5,939 MW, 800 MW less than if the Proposed Action were approved.

Accidental releases: The proposed Project could release air toxics or hazardous air pollutants because of accidental chemical spills. The Proposed Action would have up to about 42,346 gallons (160,297 liters) of coolants, 506,559 gallons (1.9 million liters) of oils and lubricants, and 84,996 gallons (321,745 liters) of diesel fuel in its 102 foundations (WTGs and ESPs) within the air quality geographic analysis area. These may lead to short-term periods of hazardous air toxic pollutant emissions such as VOC’s through evaporation. VOC emissions would also be an important precursor to ozone formation. Air quality impacts would be short-term and limited to the local area at and around the accidental release location. BOEM anticipates that these activities would have a **negligible** air quality impact as a result of the Proposed Action. The change in risk to or impact on air quality in the air quality geographic analysis area due to offshore wind development is very small. The frequency of accidental release events would be very small. If it occurs, it is anticipated that the cumulative air quality impact would be short-term and spatially limited. Cumulatively, there would be up to about 288,415 gallons (1.13 million liters) of coolants, 3,466,083 gallons (13.1 million liters) of oils and lubricants, and 579,628 gallons (2.2 million liters) of diesel fuel contained within the 695 foundations between the Proposed Action and future offshore projects in the air quality geographic analysis area. BOEM expects that the cumulative impacts on air quality from accidental releases associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would have **negligible** impacts due to the short-term nature and localized potential effects. Accidental spills would occur infrequently over the 30-year period with a higher probability of spills during construction of projects, but they would not be expected to contribute appreciably to overall impacts on air quality as the total storage capacity within the geographic analysis area for air is considerably less than the volumes of hazardous liquids being transported by ongoing activities.

Air emissions: The proposed Project’s incremental contribution of up to 325,255 tons of construction emissions would be additive with the impact(s) of any and all other construction activities, including future offshore wind activities, that occur within the air quality geographic analysis area before the resource has recovered from the impact caused by the proposed Project. The Proposed Action construction emissions are estimated to be 4,961 tons of NO_X, 122 tons of VOC, 1,116 tons of CO, 172 tons of PM_{10}, and 38 tons of SO_2. Note that both NOx and VOC are ozone precursors and these emissions may contribute to some increase in ozone production during construction. BOEM anticipates **minor** air quality impacts due to the construction and installation of the Proposed Action. Using the assumptions in Table A-4, the Proposed Action, when combined with past, present, and reasonably foreseeable activities, could generate up to approximately 2,215,929 tons of construction emissions between 2021 and 2030. Construction overlap between projects would begin in 2022 based on the lease areas within the air quality geographic analysis area. Primary emission sources would be increased commercial vessel traffic, air traffic, public vehicular traffic, combustion emissions from construction equipment, and some fugitive emissions. The largest emissions and air quality impacts would occur during construction and decommissioning. Construction impacts would also likely affect air quality over a larger spatial area in comparison to operations because of the increased emissions during various construction activities. Smaller emissions and lower magnitude air quality impacts would occur during decommissioning. As the Proposed Action and other future offshore wind projects come online, power generation emissions in the region overall would reduce emissions over time and this would contribute to a net benefit on air quality regionally. Most air quality impacts would remain offshore since the highest emissions would occur in this region and the westerly prevailing winds would result in most plumes to remaining offshore (Draft EIS Section 3.2.1). Cumulatively, the Proposed Action when combined with past, present, and reasonably foreseeable activities, would be required to comply with the CAA and emissions might exceed *de minimis* thresholds, requiring offsets and mitigation.

Air quality impacts due to offshore wind projects within the air quality geographic analysis area is anticipated to be small relative to larger emission sources such as fossil fuel facilities. The largest air quality impacts are anticipated during construction with smaller and more infrequent impacts anticipated during decommissioning. The Proposed Action would contribute an approximately 15 percent increase from each criteria pollutant due to construction and decommissioning activities when compared to the projects within the air quality geographic analysis area. This suggests that most of the air quality impacts would be due to other offshore wind projects in total and the addition of the Proposed Action would yield a very small contribution to the total air quality impacts. The largest cumulative air quality impacts would occur during overlapping construction/decommissioning of multiple offshore wind projects. Based on the emissions data, a conservative assumption would yield about a 15 percent increase in air pollutant concentrations due to construction of the Proposed Action. Based on the cumulative assumptions in Table A-4, the Vineyard Wind 1 Project, Sunrise Wind Project, and Revolution Wind are anticipated to overlap for 1 year of construction beginning in 2022, resulting in about 10,362 tons of criteria pollutants and about 502,208 tons of CO_2 construction emissions. The first year of construction of Sunrise Wind and Revolution Wind would overlap with the second year of the proposed Project construction (2022) and the other wind projects within the air quality geographic analysis area would overlap with the Vineyard Wind 1 Project's operations. The cumulative impacts on air quality from construction air emissions associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be **minor** during construction and decommissioning. During overlapping construction activities, there could be higher levels of impacts but these effects would be short-term in nature as the overlap in the air quality geographic analysis area would be limited in time.

During operations and maintenance, air quality impacts are anticipated to be smaller in magnitude than compared to construction/decommissioning. The operations and maintenance of the Proposed Action would generate fewer emissions than construction since it would involve only limited vessel and commercial traffic and operation of emergency equipment would only occur infrequently. The proposed Project's incremental contribution of up to 5,583-tons per year of operations emissions, of which 96 tons per year would be from criteria pollutants, would be additive with the impact(s) of any and all other operations activities, including offshore wind activities, that occur within the air quality geographic analysis area. The Proposed Action operations emissions for the criteria pollutants are about 71 tons per year of NO_X, 2 tons per year of VOC, 18 tons per year of CO, 2 tons per year of both PM_{10} and $PM_{2.5}$, and less than 1 ton per year of SO_2. Both NO_X and CO have the highest estimated emissions due to operations. BOEM anticipates that air quality impacts from operations and maintenance of the Proposed Action would be **minor**, occurring for short blocks of time, several times per year during the proposed 30 years. Using the assumptions in Table A-4, the cumulative impacts on air quality from operations and maintenance air emissions of the Proposed Action, when combined with past, present, and reasonably foreseeable activities, could generate up to approximately 38,038 tons per year of operations emissions in the air quality geographic analysis area beginning in 2022 and continuing through 2030. Emissions would largely be due to 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. Cumulative emissions from the Proposed Action when combined with past, present, and reasonable foreseeable activities are estimated to be: 482 tons per year of NO_X, 14 tons per year of VOC, 123 tons per year of CO, 16 tons per year both of PM_{10} and $PM_{2.5}$, and 2 tons per year of SO_2. Anticipated cumulative impacts on air quality from operations and maintenance air emissions of the Proposed Action when combined with past, present, and reasonably foreseeable activities, would be transient, small in magnitude, and localized. Additionally, some emissions associated with operations and maintenance activities could overlap with other projects' construction-related emissions. This shows that the Proposed Action contributions are less for the operations and maintenance phase than for the construction phase and that the increase in air quality impacts are anticipated to be small relative to the other planned offshore wind projects. In summary, the largest magnitude air quality impacts and largest spatial extent would result from the overlapping operations activities from the multiple offshore wind projects within the air quality geographic analysis area. The cumulative impacts on air quality due to operations and maintenance associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be **minor**. A net improvement in air quality is expected on a regional scale as projects come online and offset emissions from fossil fuel-type sources.

Increases in renewable energy can result in significant reductions in fossil fuel-type emissions. Once operational, the Vineyard Wind 1 Project would result annual avoided emissions of 1,632,822 tons CO_2, 1,046 tons NOx, and 855 tons SO_2. Accounting for construction emissions and assuming decommissioning emissions would be the same, the Vineyard Wind 1 Project would offset emissions related to its development and eventual decommissioning within 8 years of operation, and from that point would be offsetting emissions that would be generated otherwise were the electricity being generated from another source. BOEM anticipates that air emissions would result in a small reduction of fossil-fuel emissions and would result in a **minor beneficial** impact on air quality. Since total actual fossil fuel emissions are much higher than total actual emissions due to renewable energy sources, a relatively small percentage reduction in fossil-fuel emissions can lead to much larger emissions reductions relative to the smaller emissions increases that would result from implementation of offshore wind projects. The cumulative impact of the Proposed Action when combined with past, present, and reasonably foreseeable activities would help reduce fossil-fuel emissions and would result in an overall **minor** impact on air quality.

Climate change: The Proposed Action and other future offshore wind projects would produce GHG emissions (nearly all CO_2) that contribute to climate change; however, these contributions would be minuscule compared to aggregate global emissions, and would be less than the emissions offset during the operation of the offshore wind facility. CO_2 is relatively stable in the atmosphere and for the most part mixed uniformly throughout the troposphere and stratosphere. Hence, the impact of GHG emissions does not depend upon the source location. Additional offshore wind projects would likely contribute a relatively small emissions increase of CO_2. The additional GHG emissions anticipated from the incremental impacts of the Proposed Action when combined with other reasonable foreseeable projects over the next 30-year period would have a **negligible** incremental contribution on existing GHG emissions. Therefore, the Proposed Action would have **negligible** impacts on climate change during these activities and an overall net **minor beneficial** impact on both GHG emissions and criteria pollutants including ozone precursors such as NOx compared to a similarly sized fossil-fuel-powered generating station or to the generation of the same amount of energy by the existing grids. Because GHG emissions spread out and mix within the troposphere, the climatic impact of GHG emissions does not depend upon the source location. Therefore, regional climate impacts are likely a function of global emissions. Development of offshore wind projects including the Proposed Action and the implementation construction, operations and maintenance, and the eventual decommissioning activities would cause some GHG emissions increase primarily through emissions of CO_2. However, these contributions would be small compared to the aggregate global emissions. The cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely result in a **minor beneficial** impact from the net decrease in GHGs as fossil-fuel-type facilities reduce operations as a result of increased energy generation from offshore wind projects. Overall, it is anticipated that there would be a net reduction in GHG emissions and no cumulative impact on global warming as a result of offshore wind projects.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from **negligible** to **minor** and **minor beneficial**. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in **minor** impacts to air quality in the geographic analysis area. The main driver for this impact rating is air emissions related to construction activities increasing commercial vessel traffic, air traffic, public vehicular traffic, combustion emissions from construction equipment, and fugitive emissions, which would be higher during overlapping construction activities but short-term in nature as the overlap would be limited. The Proposed Action would contribute to the overall impact rating primarily through short-term construction emissions as a result of construction vessels. Thus, the overall cumulative impacts on air quality would likely qualify as **minor** because the measurable impact that would occur would be small and would be expected to recover completely without remedial or mitigating action.

A.8.1.2.2 Cumulative Impacts of Alternatives B, C, D1 and D2

The direct and indirect impacts of Alternatives B, C, D1, and D2 on air quality are described in Draft EIS Sections 3.2.1.4, 3.2.1.5, and 3.2.1.6. The only difference between Alternative B and the Proposed Action is the selection of Covell's Beach as the landfall site. The direct and indirect impacts resulting from individual IPFs associated with Alternatives B, C, D1, and D2 would be very similar to those of the Proposed Action—**negligible** to **minor**. Alternative B would be different from the Proposed Action in that the emissions would be emitted at a different landfall location. Alternative C may have slightly higher emissions due to increased travel routes and distance for construction and maintenance vessels because of the shift in the six northernmost turbine locations. Alternatives D1 and D2 could potentially have some slight change to where the emissions occur due to different travel patterns, and additional site characterization surveys may cause local temporary impacts that are difficult to detect. However, the resulting emissions from these alternatives would be very similar to those of the Proposed Action. No change in the assessed level of air quality impacts would occur. There would be a net **minor beneficial** impact on the air quality of the proposed Project area and the surrounding region for Alternatives B, C, D1, and D2.

The cumulative impacts resulting from individual IPFs associated with Alternatives B, C, D1, and D2 would be very similar to those of the Proposed Action, as discussed in the preceding paragraphs, with individual IPFs leading to impacts ranging from **negligible** to **minor** and **minor beneficial**). The overall cumulative impacts of Alternatives B, C, D1, and D2 when combined with past, present, and reasonably foreseeable activities on air quality would be of the same level as under the Proposed Action—**minor**. This impact rating is driven mostly by construction emissions.

A.8.1.2.3 Cumulative Impacts of Alternative E

As discussed in Draft EIS Section 3.2.1.7, the direct and indirect impacts under Alternative E would result in overall fewer emissions from construction and installation than the Proposed Action due to the use of smaller amounts of construction equipment, which would reduce combustion emissions, the decrease in vessel traffic and material handling, including potential reduction in excavation and vehicular dust, which would minimize fugitive emissions. A smaller number of WTGs would also translate to a reduced number of emergency generation equipment, thus decreasing combustion emissions. IPFs associated with the installation of no more than 84 WTGs, including air emissions, would be reduced by approximately 16 percent compared to the maximum-case scenario under the Proposed Action, namely 100 WTGs. As a result, BOEM anticipates **negligible** to **minor** air quality impacts for limited periods and a net **minor beneficial** impact on the air quality of the proposed Project area and the surrounding region for Alternative E.

Changes to the design capacity of the WTG would not alter the maximum potential impacts on air because the maximum-case scenario involves assessing 84 WTGs, the maximum number for this analysis. Furthermore, the additional acreages required for the proposed onshore substation would not alter the air quality impacts.

The cumulative impacts resulting from individual IPFs associated with Alternative E would be very similar to the cumulative impacts under the Proposed Action (with individual IPFs leading to impacts ranging from **negligible** to **minor** and **minor beneficial**). The overall cumulative impacts of Alternative E when combined with past, present, and reasonably foreseeable activities would be of the same level as under the Proposed Action—**minor**. This impact rating is driven mostly by construction emissions.

A.8.1.2.4 Direct, Indirect, and Cumulative Impacts of Alternative F

Alternative F analyzes a vessel transit lane through the Wind Development Area (WDA), in which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The WTGs that would have been located within the transit lane would not be eliminated from the Proposed Action; instead, the displaced WTGs would be shifted to locations south within the Lease Area. Under this alternative, BOEM is analyzing a 2- and 4-nautical-mile northwest/southeast vessel transit lane through the WDA combined with any action alternative; however this analysis focuses on the combination of Alternative F with either the Proposed Action or Alternative D2 layout. Therefore, the number of turbines would remain the same. The northern transit lane within the WDA could result in the relocation of 16 to 34 WTGs and a 12 to 61 percent increase in the size of the WDA, and therefore, a likely increase in the amount of inter-array cables. As stated previously, the geographic analysis area includes the airshed within 15.5 miles (25 km) of each area potentially impacted by the proposed Project. As a result, and because WTGs would be relocated further south of the WDA as a result of the transit lane, Alternative F in combination with any other alternative or combination of alternatives would expand the area of potential effect for air quality. The direct and indirect impacts of Alternative F on air quality would be similar to those of the Proposed Action and Alternative D2 but potentially with some slightly higher emissions due to increased travel routes and distance for construction and maintenance vessels. The northern transit lane could require up to 34 WTGs from the WDA to be shifted to the southern portion of the lease area, and additional surveys. Such site characterization surveys may cause local temporary impacts that are difficult to detect; however, the resulting emissions would be similar to those of the Proposed Action and Alternative D2. No change in the assessed level of air quality impacts would occur. As a result, BOEM anticipates that there would be **negligible** to **minor** air quality impacts for limited periods and a net **minor beneficial** impact on the air quality within the proposed Project area and the surrounding region for Alternative F. The direct and indirect impacts from the combination of Alternative F with the Proposed Action or Alternative D2 are expected to be similar to combinations with the other action alternatives. Consequently, these other potential combinations are not separately analyzed here.

In considering the cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities, BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521, and northwest through lease area OCS-A 0500. The cumulative impacts of Alternative F would be very similar to the cumulative impacts under the Proposed Action (with individual IPFs leading to impacts ranging from **negligible** to **minor** and **minor beneficial**). The overall cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities would be of the same level as under the Proposed Action—**minor**. This impact rating is driven by a blend of higher impacts during construction emissions to a minor beneficial impact during the operational phase.

BOEM has qualitatively evaluated the cumulative impacts of implementing all six RODA-recommended transit lanes, including the northern transit lane described for Alternative F, as well as five other transit lanes through the RI and MA Lease Areas. To the extent additional transit lanes are implemented in the future outside the WDA as part of RODA's suggestion, the WTGs for future offshore wind projects may need to be located farther from shore, similar to the proposed Project under Alternative F. As discussed in SEIS Section 3.4.2, if all the proposed transit lanes were implemented, this would not allow the technical capacity of offshore wind power generation assumed in SEIS Chapter 1 to be met. If in the future all six transit lanes were implemented, the overall number of WTGs would likely be less but the additional transit lanes could require longer vessel trips for all phases of future projects (construction, operations, maintenance, and decommissioning). As would be the case for the proposed Project, other project infrastructure located further from shore could also require and longer timeframes for cable installation. These effects could result in more air emissions overall due to construction vessels transiting the OCS.

A.8.1.2.5 Comparison of Alternatives

As discussed in Draft EIS Section 3.2.1.9, the direct and indirect impacts resulting from individual IPFs associated with the Proposed Action would not change substantially under Alternatives B through F, with **negligible** to **minor** air quality impacts for a limited time during construction, operations, and decommissioning phases. Alternatives C, D, and F may have slightly higher emissions than Alternatives A and B due to increased travel distances for vessels and some shift in the locations of turbines and other offshore infrastructure. As a result, some additional air quality impacts may occur for Alternatives C, D, and F when compared with Alternatives A and B. For Alternative E, BOEM expects lower air quality impacts than those of the Proposed Action due to a reduction in size of the wind project compared to the other alternatives. BOEM anticipates a net **minor beneficial** air quality impact as a result of the proposed Project from a potential reduction in the need to install additional fossil fuel-generating stations or modify existing fossil fuel-generating stations.

Air emissions and other IPFs of the Proposed Action, when combined with past, present, and reasonably foreseeable activities, could result in cumulative impacts whenever the resource is stressed before it has completely recovered from previous impacts. Cumulative impacts under any action alternative would likely be very similar because the majority of the cumulative impacts of any alternative come from other future offshore wind development, which does not change between alternatives. Because the emissions related to onshore and offshore activities would be widely dispersed and transient, BOEM expects all air quality impacts to occur close to the emitting sources. Thus, BOEM expects short-term transient increases in air quality cumulative impacts from the interaction of emissions at various locations within the air quality geographic analysis area. BOEM expects that the Proposed Action and action alternatives, when combined with past, present, and reasonably foreseeable activities, would result in **negligible** to **minor** impacts. However, there would still be net **minor beneficial** cumulative air quality impacts. Since the Proposed Action and action alternatives in combination with other reasonably foreseeable offshore wind facility developments would provide additional power generation to the area and help states reach established renewable energy generation goals, existing fossil fuel facilities may spend less time generating energy and the development of additional fossil fuel facilities may not be needed or would be limited, resulting in a net regional air quality benefit. BOEM expects that the Proposed Action, when combined with past, present, and reasonably foreseeable activities, would result in short-term transient increases in air emissions; however, there would still be net minor beneficial cumulative air quality impacts. The overall level of cumulative impacts of any alternative when combined with past, present, and reasonably foreseeable activities would be minor, which is largely driven by construction emissions.

Table A-7: Summary of Activities and the Associated Impact-Producing Factors for Air Quality

Baseline Conditions: Air quality within a region is measured in comparison to the NAAQS, which are standards established by the USEPA pursuant to the CAA (42 United States Code § 7409) for criteria pollutants to protect human health and welfare. The criteria pollutants are CO, SO2, PM10, PM2.5, NO2, ozone, and lead. The overall geographic analysis area for air quality covers most of Rhode Island, southeastern Massachusetts eastward across Cape Cod, southward across Martha's Vineyard and over the open ocean south of Martha's Vineyard.

This geographic analysis area for air quality is changed from that described in the Draft EIS due to removal of ports. At its nearest point, the Wind Development Area is just over 14 miles (23 kilometers) from the southeast corner of Martha's Vineyard, in Dukes County. All of southeastern Massachusetts is presently designated as unclassifiable or attainment for all criteria pollutants. The exception is Dukes County on Martha's Vineyard, which is designated as marginally nonattainment for the 2008 Ozone NAAQS. This designation was based on data collected at the Herring Creek Road Aquinnah monitor (Monitor #25-007-0001) from 2009 to 2011, which showed a monitored concentration of 76 ppb versus the 2008 NAAQS of 75 ppb. While the 2008 NAAQS is still technically in effect, Dukes County was recently (August 2018) designated attainment against the more stringent 2015 ozone NAAQS of 70 ppb, based on the 2014 to 2016 monitored concentration of 64.3 ppb. Thus, while the 2008 designation has not yet been changed, monitored values in Dukes County have significantly improved since 2011 and are now in attainment with the 2008 ozone NAAQS standard.

The entire state of Rhode Island is currently in attainment for all criteria pollutants.

See Draft EIS Section 3.2.1 for additional details.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/ hazmat	Accidental releases of air toxics HAPS are due to potential chemical spills. Ongoing releases occur in low frequencies. These may lead to short-term periods of toxic pollutant emissions through surface evaporation. According to the U.S. Department of Energy, 31,000 barrels (4.9 million liters) of petroleum are spilled into U.S. waters from vessels and pipelines in a typical year. Approximately 40.5 million barrels (6.4 billion liters) of oil were lost as a result of tanker incidents from 1970 to 2009, according to International Tanker Owners Pollution Federation Limited, which collects data on oil spills from tankers and other sources. From 1990 to1999, the average annual input to the coastal Northeast was 220,000 barrels of petroleum and offshore it was up to less than 70,000 barrels.	Accidental releases of air toxics or HAPS will be due to potential chemical spills. See A-8 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. These may lead to short-term periods of toxic pollutant emissions through evaporation. Air quality impacts will be short-term and limited to the local area at and around the accidental release location.	Accidental releases of air toxics or HAPS will be due to potential chemical spills over the next 30 years infrequently during construction but could also occur during operations. Up to about 246,069 gallons (931,473 liters) of coolants, 2,959,524 (11.2 million liters) of oils and lubricants, and 494,632 gallons (1.8 million liters) of diesel fuel will be contained in the 581 foundations (WTGs and ESPs) for the wind energy projects within the air quality analysis area, excluding the Proposed Action. These may lead to short-term periods of toxic pollutant emissions through evaporation. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities. Air quality impacts would be short-term and limited to the local area at and around the accidental release location. Accidental releases from future offshore wind development would not be expected to contribute appreciably to overall impacts on air quality.	Accidental releases of air toxics or HAPS would be due to potential chemical spills. The Proposed Action would have up to about 42,346 gallons (160,297 liters) of coolants, 506,559 gallons (1.9 million liters) of oils and lubricants, and 84,996 gallons (321,745 liters) of diesel fuel in its 102 foundations (WTGs and ESPs). These may lead to short-term periods of toxic pollutant emissions through evaporation. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities. Air quality impacts would be short-term and limited to the local area at and around the accidental release location. Accidental releases from future offshore wind development would not be expected to contribute appreciably to overall impacts on air quality. BOEM anticipates that these activities would have a negligible air quality impact on the proposed Project area and the surrounding region.	The accidental release of air toxics or HAPS from the Proposed Action would be due to potential spills. These may lead to short-term periods of toxic pollutant emissions through surface evaporation. Air quality impacts would be short-term and limited to the local area at and around the accidental release location. Air quality impacts due to accidental releases associated with the Proposed Action would be negligible. The impacts from ongoing activities and future non-offshore wind activities would also be due to the potential for chemical spills and may lead to short-term periods of toxic pollutant emissions through evaporation. Future offshore wind activities would contribute a small amount to the change in risk or impact on air quality as the frequency of accidental release events would be very small and likely infrequent. If a release were to occur, the air quality impact would be short-term and spatially limited. The contribution from future offshore wind and the Proposed Action would be a low percentage of the overall spill risk from ongoing activities. Cumulatively, the impacts on air from this sub-IPF are expected to be localized and temporary due to the likely limited extent and duration of a release, described in detail in the Draft EIS Section 3.2.2.3 on Water Quality. Accidental releases from future offshore wind development including the Proposed Action would not be expected to contribute appreciably to overall impacts on air quality. BOEM expects that the Proposed Action, when combined with past, present, and reasonable foreseeable activities, would have negligible impacts from this sub-IPF due to the short-term nature and localized potential effects.
Air emissions: Construction and decommissioning	Air emissions originate from combustion engines and electric power generated by burning fuel. These activities are regulated under the CAA to meet set standards. Air quality has generally improved over the last 30 years; however, some areas in the Northeast have experienced a decline in air quality over the last 2 years. Some areas of the Atlantic coast remain in nonattainment for ozone, with the source of this pollution from power generation. Many of these states have made commitments toward cleaner energy goals to improve this, and offshore wind is part of these goals. Primary processes and activities that can affect the air quality impacts are expansions and modifications to existing fossil fuel power plants, onshore and offshore activities involving renewable energy facilities, and various construction activities.	The largest air quality impacts over the next 30 years will occur during the construction phase of any one project; however, projects will be required to comply with the CAA. During the limited construction and decommissioning phases, emissions may occur that are above *de minimis* thresholds and will require offsets and mitigation. Primary emission sources will be increased commercial vehicular traffic, air traffic, public vehicular traffic, and combustion emissions from construction equipment and fugitive emissions from construction-generated dust. As projects come online, power generation emissions overall will decline and the industry as a whole will have a net benefit on air quality.	Projects will be required to comply with the CAA. During the limited construction and decommissioning phases, emissions may occur that are above *de minimis* thresholds and will require offsets and mitigation. Primary emission sources from future offshore wind activities will be increased commercial vessel traffic, air traffic, public vehicular traffic, and combustion emissions from construction equipment. The wind projects under development or planned with the air quality geographic analysis area are all located adjacent to each other and will increase the air quality impacts in general during the construction phase. The magnitude of the air quality emissions will vary and be dependent on which projects overlap during the construction phase. It is anticipated that Sunrise Wind and Revolution Wind projects would overlap with 1 year of the Proposed Action's construction phase. The other offshore wind projects within the air quality geographic analysis area would overlap during the operations phase. As projects come online, power generation emissions overall will decline and the industry as a whole will have a net benefit on air quality. For all the construction-phase emissions of criteria pollutants (NO_X, SO_2, CO, PM_{10}, $PM_{2.5}$, and VOCs) within the geographic analysis area, the percentage of NO_X is approximately 75%, SO_2 is approximately 1%, CO is approximately 17%, VOC is approximately 2% and particulates approximately 6% of the total construction criteria pollutant emissions (38,220 tons)	The Proposed Action would result in up to 325,255 tons of construction emissions. Because the construction and installation phase of the offshore components would likely not extend past 2 years and because the emissions would vary throughout the phase, BOEM does not expect projected air quality impacts to exceed the NAAQS for these pollutants. Overall, BOEM anticipates minor air quality impacts due to the construction and installation of offshore components due to the limited time of the activities. As the Vineyard Wind 1 Project comes online, power generation emissions in the region overall would reduce emissions and this would contribute to a net benefit on air quality regionally. See Draft EIS Section 3.2.1 for more details.	The Proposed Action would result in 325,255 tons of construction emissions. Although there would be some air quality impacts due to various activities associated with construction and eventual decommissioning, these emissions would be relatively small and limited in duration. Overall, BOEM anticipates minor air quality impacts during the limited time of construction and installation of offshore components. The impacts from ongoing activities and future non-offshore wind activities would also result in construction-related emissions primarily from increased commercial vehicular traffic, air traffic, public vehicular traffic, and combustion emissions from construction equipment and fugitive emissions from construction-generated dust. Future offshore wind activities would contribute construction-related emissions, but would also be relatively small and limited in duration similar to the Vineyard Wind 1 Project. Short-term and variable cumulative impacts on air quality within the Project Area are possible during the construction and decommissioning phase. The overall construction-related air quality impacts due to offshore wind projects are anticipated to be small relative to larger emission sources such as fossil fuel facilities. The Proposed Action, when combined with past, present, and reasonably foreseeable activities, could generate up to approximately 2,215,929 tons of construction emissions within the air quality geographic analysis area between 2021 and 2030. The largest air quality impacts are anticipated during the construction phase with smaller and more infrequent impacts anticipated during decommissioning. The largest and most spatially widespread cumulative air quality impacts would occur during overlapping construction/ decommissioning phases of multiple wind projects. Based on the cumulative assumptions in Appendix A the Vineyard Wind 1 Project, Sunrise Wind Project, and Revolution Wind are anticipated to overlap for 1 year of construction beginning in 2022, resulting in a total of about 10,362 tons of criteria pollutants and about 502,208 tons of CO_2 construction emissions. The first year of construction of Sunrise Wind and Revolution Wind would overlap with the second year of the proposed Project construction (2022). The other wind projects within the geographic analysis area will overlap with the Vineyard Wind 1 Project operations phase. Anticipated cumulative air quality impacts would be transient, small in magnitude, and localized.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			for the construction phase. The CO_2 construction emissions make up the largest percentage of total construction-phase emissions, resulting in about 1.9 million tons of CO_2 emissions for the projects within the air quality geographic analysis area. Based on the assumed construction schedule presented in Appendix A projects within the analysis area will have overlapping construction periods beginning in 2022 and continuing through 2030.		Cumulative impacts on air quality from construction air emissions associated with the Proposed Action and past, present, and reasonably foreseeable activities would be minor to moderate during construction and decommissioning. During overlapping construction activities there could be more moderate impacts but these effects would be short-term in nature as the overlap in the air quality geographic analysis area would be limited in time.
Air emissions: O&M		Activities associated with operation and maintenance of onshore wind projects will have a proportionally very small contribution to emissions compared to the construction and decommissioning activities over the next 30 years. Emissions will largely be due to commercial vehicular traffic and operation of emergency diesel generators. Such activity will result in short-term, intermittent, and widely dispersed emissions and small air quality impacts.	Operations and maintenance activities will have a proportionally very small contribution to emissions compared to the construction and decommissioning phases, but could occur each month during operations and maintenance. Emissions will largely be due to commercial vessel traffic and operation of emergency diesel generators. Such activities would result in short-term, intermittent, and widely dispersed emissions. Anticipated air quality impacts would be transient and small in magnitude. The largest air quality impacts would occur during overlapping operational activities. Anticipated air quality impacts would be transient and small in magnitude. Operational phase air emissions of criteria pollutants (NO_X, SO_2, CO, PM_{10}, $PM_{2.5}$, and VOC) within the air quality geographic analysis area show that most of the emissions would be from NO_X (412 tons per year [74% of the total operational criteria pollutant emissions]) and CO (105 tons per year [19% of the total operational criteria pollutant emissions]) due to combustion emissions. The other criteria pollutants for the future offshore wind projects within the air quality geographic analysis area, such as PM_{10}, $PM_{2.5}$, and SO_2, each account for less than 3% of the total operational emissions for all future offshore wind projects within the air quality analysis area.	Operations and maintenance activities would have a proportionally very small contribution to emissions compared to the construction and decommissioning phases, but could occur each month during operations and maintenance. The air emissions from the Proposed Action would begin in 2022 and continue through 2030. Emissions would largely be due to 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 air quality impacts would be transient, small in magnitude, and localized. Possible use of larger but fewer turbines would reduce the air quality impacts. See Draft EIS Section 3.2.1 for more details. The operations and maintenance of the Proposed Action would be less than the construction phase since it would only involve limited vessel and commercial traffic and operation of emergency equipment that would not occur frequently. The Proposed Action's incremental contribution of up to 5,583 tons per year of operations emissions, of which 96 tons per year would be from criteria pollutants, would be additive with the impact(s) of any and all other operations activities, including offshore wind activities, that occur within the air quality geographic analysis area. BOEM anticipates that air quality impacts of operations and maintenance of offshore components would be minor, occurring for short blocks of time several times per year during the proposed 30 years.	The operations and maintenance of the Proposed Action would generate fewer emissions than the construction phase since it would only involve limited vessel and commercial traffic and emergency equipment operation would occur infrequently. The Proposed Action would result in 5,583 tons per year of operations emissions during the proposed 30 years. BOEM anticipates that air quality impacts of operations and maintenance of the Proposed Action would be minor, occurring for short blocks of time several times per year. The impacts from ongoing activities and future non-offshore wind activities would largely be due to commercial vehicular traffic and operation of emergency diesel generators. Such activities would result in short-term, intermittent, and widely dispersed emissions and small air quality impacts. Future offshore wind activities would contribute operations-related emissions, but would have a proportionally very small contribution to emissions compared to the construction and decommissioning phases. Emissions would largely be due to commercial vessel traffic and operation of emergency diesel generators. Using the assumptions in Appendix A the cumulative impacts on air quality from operations and maintenance air emissions with the Proposed Action when combined with past, present, and reasonably foreseeable activities could be up to approximately 38,038 tons per year of operations emissions in the air quality geographic analysis area beginning in 2022 and continuing through 2030. Emissions would largely be due to 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 operations and maintenance air emissions from the Proposed Action, combined with past, present, and reasonably foreseeable activities, would be localized, transient, and minor. The largest magnitude air quality impacts and largest spatial extent would result from the overlapping operations activities from the multiple wind projects within the air quality geographic analysis area. Additionally, some emissions associated with operations and maintenance activities could overlap with other projects' construction-related emissions. A net improvement in air quality is expected on a regional scale as projects come online and offset emissions from fossil-fuel type sources. The cumulative impacts on air quality due to operations and maintenance associated with the Proposed Action and past, present, and reasonably foreseeable activities would be minor.
Air emissions: Power generation emissions reductions		Many Atlantic states have committed to clean energy goals, with offshore wind being a large part of that. Other reductions include transitioning to onshore wind and solar. The No Action Alternative without implementation of other future offshore wind projects would likely result in increased air quality impacts regionally due to the need to construct and operate new energy generation facilities to meet future power demands. These facilities may consist of new natural-gas-fired power plants, coal-fired, oil-fired, or clean-coal-fired plants. These types of facilities would likely have larger and continuous emissions and result in greater regional scale impacts on air quality.	Significant reductions in fossil-fuel type emissions can result from the increases in renewable energy. Based on an analysis by Katzenstein and Apt (2009), CO_2 emissions can be reduced by up to 80% and NO_X emissions can be reduced up to 50% due to implementation of wind energy projects. A quantitative emissions inventory analysis is needed to more accurately assess these overall emissions reductions. Since fossil-fuel-type emissions are much higher than emissions due to renewable energy sources, a relatively small percentage reduction in fossil-fuel emissions can lead to much larger emissions reductions relative to the smaller emissions increases that would result from implementation of offshore wind projects.	Once operational, the Vineyard Wind 1 Project would have annual avoided emissions of 1,632,822 tons CO_2, 1,046 tons NOx, and 855 tons SO_2. Accounting for construction emissions and assuming decommissioning emissions would be the same, the Vineyard Wind 1 Project would have offset emissions related to its development and eventual decommissioning within 8 years of operation, and from that point would be offsetting emissions that would be generated otherwise were the electricity being generated from another source. BOEM anticipates that air emissions would result in a small reduction of fossil-fuel emission and would result in a minor beneficial impact on air quality.	The Proposed Action would result in avoided emissions that would be generated otherwise by another power source. Once operational, the Vineyard 1 Project would avoid annual emissions of 1,632,822 tons CO_2, 1,046 tons NOx, and 855 tons SO_2. BOEM anticipates that air emissions would result in a small reduction of fossil-fuel emissions and would result in a minor beneficial impact on air quality. The impacts from ongoing activities and future non-offshore wind activities would continue to contribute emissions from non-renewable sources until states meet their committed clean energy goals. Future offshore wind activities would contribute an increase in renewable energy production ultimately leading to reductions in fossil fuel emissions similar to the Vineyard Wind 1 Project. Based on an analysis by Katzenstein and Apt (2009), CO_2 emissions can be reduced by up to 80% and NOx emissions can be reduced up to 50%t due to implementation of wind energy projects. Since fossil-fuel type emissions are typically much higher than emissions due to renewable energy sources, a relatively small percentage reduction can lead to much larger emissions reductions relative to the smaller emissions increases that would result from implementation of offshore wind projects. The cumulative impact of the Proposed Action when combined with past, present, and reasonably foreseeable activities would help to reduce fossil-fuel emissions and result in a net minor beneficial impact on air quality.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Climate change	The construction, operation, and decommissioning of offshore wind projects would produce GHG emissions (nearly all CO_2) that can contribute to climate change; however, these contributions would be minuscule compared to aggregate global emissions. CO_2 is relatively stable in the atmosphere and generally mixed uniformly throughout the troposphere and stratosphere. Hence the impact of GHG emissions does not depend upon the source location. Increasing energy production from offshore wind projects will likely to decrease GHGs emissions by replacing energy from fossil fuels.	Development of future onshore wind projects will produce a small overall increase in GHG emissions over the next 30 years. However, these contributions would be very small compared to the aggregate global emissions. The impact on climate change from these activities would be very small. As more projects come online, some reduction in GHG emissions from modifications of existing fossil fuel facilities to reduce power generation. Overall, it is anticipated that there would be no cumulative impact on global warming as a result of onshore wind project activities.	Development of offshore wind projects and the construction, implementation, operation, maintenance, and the eventual decommissioning will cause some minuscule GHG emissions increase primarily through emissions of CO_2. Overall there should be some net reduction on both GHG emissions and criteria pollutants, including ozone precursors such as NOx, through reduction in emissions from fossil fuel generation facilities. In general, the GHG emissions associated with the construction, maintenance, and eventual decommissioning of future offshore wind projects can be assumed to contribute to climate change. However, these contributions would be minuscule compared to the aggregate global emissions of GHGs; therefore, they cannot be deemed significant, if their impact could even be detected.	The construction, operation, and decommissioning activities associated with the Proposed Action would produce GHG emissions (nearly all CO_2) that can contribute to climate change; however, these contributions would be minuscule compared to aggregate global emissions. CO_2 is relatively stable in the atmosphere and generally mixed uniformly throughout the troposphere and stratosphere. Hence the impact of GHG emissions does not depend upon the source location. Increasing energy production from offshore wind projects will likely to decrease GHGs emissions by replacing energy from fossil fuels. In general, the GHG emissions associated with the construction, maintenance, and eventual decommissioning of the Proposed Action can be assumed to contribute to climate change. However, these contributions would be small compared to the aggregate global emissions of GHGs; therefore, they cannot be deemed significant, if their impact could even be detected. The additional GHG emissions anticipated from the Proposed Action over the 30-year period would have a negligible incremental contribution on existing GHG emissions. Therefore, the Proposed Action would have negligible impacts on climate change during these activities and an overall minor beneficial impact on both GHG emissions and criteria pollutants, including ozone precursors such as NOx, compared to a similarly sized fossil-fuel-powered generating station or to the generation of the same amount of energy by the existing grids.	The Proposed Action would produce GHG emissions as stated above; however, the contributions would be minuscule compared to aggregate global emissions. The additional GHG emissions anticipated from the Proposed Action over the 30-year period would have a negligible incremental contribution on existing GHG emissions. Therefore, the Proposed Action would have negligible impacts on climate change during these activities and an overall minor beneficial impact on GHG emissions compared to the generation of the same amount of energy by the existing grids. Because GHG emissions spread out and mix within the troposphere, the climatic impact of GHG emissions does not depend on the source location. Therefore, regional climatic impacts are a function of global emissions. Development of offshore wind projects and the construction, implementation, operation, maintenance, and the eventual decommissioning activities will cause some GHG emissions increases primarily through emissions of CO_2. However, these contributions would be minuscule compared to aggregate global emissions. The cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely result in a minor beneficial impact from the net decrease in both GHG emissions and criteria pollutants, including ozone precursors such as NOx, as fossil-fuel type facilities reduce operations as a result of increased energy generation from offshore wind projects. Overall, it is anticipated that there would be no cumulative impact on global warming as a result of offshore wind projects, including the Proposed Action alone, though they may beneficially contribute to a broader combination of actions to reduce future impacts from climate change.

% = percent; BOEM = Bureau of Ocean Energy Management; CAA = Clean Air Act; CO = carbon monoxide; Draft EIS = Draft Environmental Impact Statement; EIS = Environmental Impact Statement; GHG = greenhouse gas; HAP = hazardous air pollutant; IPF = impact producing factor; NAAQS = National Ambient Air Quality Standards; NO2 = nitrogen dioxide ; NOx = nitrogen oxides; O&M = operations and maintenance; PM2.5 = particulate matter with diameters 2.5 microns or smaller; PM10 = particulate matter with diameters 10 microns or smaller; ppb = parts per billion; SO2 = sulfur dioxide; USC = United States Code; USEPA = U.S. Environmental Protection Agency; VOC = volatile organic compounds

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A.8.2. Water Quality

A.8.2.1. No Action Alternative Impacts

Table A-8 contains a detailed summary of baseline conditions and the impacts of ongoing and future offshore activities other than offshore wind on water quality, based on the IPFs assessed. This information comes primarily from the Draft EIS, supplemented by information developed in responding to comments on the Draft EIS and additional information. The impact analysis is limited to impacts within the geographic analysis area for water quality as described in Table A-1 and shown on Figure A.7-15. Specifically, this includes a 10-mile (16.1-kilometer) radius around the WDA, the OECC, and vessel approach routes to port facilities that would be used by the proposed Project.

Impacts on water quality include terrestrial runoff, terrestrial point source discharges, and atmospheric deposition. Additional activities that impact the water quality condition include urbanization, forestry practices, municipal waste discharges, agriculture, marine vessel traffic-related discharges, wastewater, persistent contaminants and marine debris, dredging and marine disposal, bridge and coastal road construction, commercial fishing, recreation and tourism, harbor, port and terminal operations, military and NASA operations, renewable energy development, natural events, and climate change. Ongoing water quality impacts, especially via dredging and harbor, port, and terminal operations, would continue regardless of the offshore wind industry, and are expected to be localized and temporary to permanent, depending on the nature of the activities and associated IPFs.

Water temperature, salinity, dissolved oxygen (DO), pH, chlorophyll a, turbidity, and nutrient levels are the key parameters characterizing ocean water quality, and help support and maintain a healthy ecosystem. Some of these parameters are accepted proxies for ecosystem health (e.g., DO, nutrient levels), while others delineate coastal habitats from marine habitats (e.g., temperature, salinity). Northeastern coastal waters are experiencing a long-term warming trend; average temperatures from 1980 to 2005 are 0.5 to 1.3 degrees Celsius (°C) warmer than average temperatures from 1890 to 1905 (Shearman and Lentz 2010). Nutrient overloading in estuaries and coastal waters goes back several decades, and increased coastal development on Cape Cod is causing increased nutrient pollution in communities, approximately 80 percent of which is due to groundwater contamination by septic systems (Cape Cod Commission 2013). Both development and increased boat traffic contribute to other contaminant levels, and these would continue regardless of the offshore wind industry.

Under the No Action Alternative, the proposed Project would not be built and hence would have no water quality impact. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. The following analysis addresses reasonably foreseeable offshore wind projects (or portions of projects) that fall within the geographic analysis area and considers the assumptions included in SEIS Section 1.2 and here in Appendix A. The analysis assumes that state offshore wind power demand could not be accommodated entirely by projects in the geographic analysis area for water quality, and the analysis does not include the impacts associated with the proposed Project. A detailed analysis of impacts associated with future offshore wind development is provided in Section A.8.2.1.1 and summarized in Table A-8. Cumulative impacts of the Proposed Action and Action Alternatives are analyzed in Section A.8.2.2.

A.8.2.1.1 Future Offshore Wind Activities (without Proposed Action)

BOEM expects these future offshore wind activities to affect water quality through the following primary IPFs.

Accidental releases: Future offshore wind activities could expose coastal offshore waters to contaminants (such as fuel, sewage, solid waste or chemicals, solvents, oils, or grease from equipment) in the event of a spill or release during routine vessel use. As stated in SEIS Section 3.13, future offshore wind projects would result in a small incremental increase in vessel traffic, with a short-term peak during construction. Vessel activity associated with construction is expected to occur regularly in the WDA beginning in 2022 and continuing through 2030 and then lessen to near-baseline levels during operation activities. Increased vessel traffic would be localized near affected ports and offshore construction areas. Increased vessel traffic in the region associated with construction for the future offshore wind scenario could increase the probability of collisions and allisions, which could result in oil or chemical spills.

Using the assumptions in Table A-4, up to about 154,144 gallons (583,499 liters) of coolants and 1.4 million gallons (5.3 million liters) of oils and lubricants will be contained in the construction of 373 foundations (WTGs and ESPs) for the wind energy projects within the water quality geographic analysis area. If lease areas within the water quality geographic analysis area are developed, there is a low risk of a leak from any of the approximately 364 WTGs, each of which stores approximately 3,830 gallons (about 14,500 liters) of oil mixture. It is assumed that each WTG would contain approximately 1,717 gallons (6,500 liters) of transformer oil, 2,113 gallons (8,000 liters) of general oil (for hydraulics and gearboxes), and 423 gallons (1,601 liters) of coolants. Each ESP (9) would contain a maximum of approximately 123,559 gallons (467,720 liters) of oils and lubricants and 46 gallons (174 liters) of coolants. The estimated total amount of the fluids housed at the ESPs under the No Action Alternative would be approximately 534,551 gallons (2.0 million liters) of oils and lubricants and 199 gallons (753 liters) of coolants. The total quantity of diesel fuel for all WTGs and ESPs would be 313,617 gallons (1.2 million liters) for the 373 foundations. The smallest fuel tanker operating in these waters (a general purpose tanker) has a capacity of between 3.2 and 8 million gallons (12.1 million to 30.3 million liters) and the total chemical storage capacity under the No Action Alternative (2,398,190 gallons [9.1 million liters]) is similar to, or less than, the volumes being transported by ongoing activities, depending on the actual sizes of vessels transiting the area (U.S. Energy Information Administration 2014).

BOEM has conducted extensive modeling to determine the likelihood and effects of a chemical spill at offshore wind facilities at three locations along the Atlantic Coast, including an area near the proposed Project area (Bejarano et al. 2013). Results of the model indicated a catastrophic, or maximum-case scenario, release of 128,000 gallons (484,533 liters) of oil mixture has a "Very Low" probability of occurring, meaning it could occur one time in 1,000 or more years. In other words, the likelihood of a given spill resulting in a release of the total container volume (such as from a WTG, ESP, or vessel) is low. The modeling effort also revealed the most likely type of spill (i.e., non-routine event) to occur is from the WTGs at a volume of 90 to 440 gallons (341 to 1,666 liters), at a rate of one time in 1 to 5 years, or a diesel fuel spill of up to 2,000 gallons (7,571 liters) at a rate of one time in 20 years. The likelihood of a spill occurring from multiple WTGs and ESPs at the same time is very low and, therefore, the potential impacts from a spill larger than 2,000 gallons (7,571 liters) are largely discountable. The modeling effort was conducted based on information collected from multiple companies and projects and would therefore apply for the 7 to 10 other projects within the northeast region assumed in BOEM's water quality geographic analysis area. For the purposes of this discussion, small-volume spills equate to the most likely spill volume between 90 and 440 gallons (341 to 1,666 liters) of oil mixture or up to 2,000 gallons (7,571 liters) of diesel fuel, while large-volume spills are defined as a catastrophic release of 128,000 gallons (484,533 liters) of material, based on modeling conducted by Bejarano et al. (2013). Small-volume spills could occur during maintenance or transfer of fluids, while low-probability small- or large-volume spills could occur due to vessel collisions, allisions with the WTGs/ESPs, or incidents such as toppling during a storm or earthquake.

The likelihood of a spill occurring during construction is low, as BOEM anticipates small vessel allisions would not cause significant damage to ESPs or WTGs. Vessels would likely have their own onboard containment measures that would further reduce the impact of an allision. The model calculates the likelihood of allision with a WTG by assuming 30 miles of exposed WTGs that could potentially be struck by an off-course vessel. However, the likelihood of a vessel crossing into the row of WTGs and actually hitting a WTG is low because a vessel is more likely to pass between the WTGs than allide with them. The likelihood of a vessel crossing into the WTG line and alliding with a WTG in any one lease area is 14.5 percent (Section 3.2.6 in Bejarano et al. 2013). Due to the low likelihood of a large (i.e., catastrophic) or small (most likely) spill for offshore wind projects, impacts on water quality during construction from spills are expected to be adverse, direct and indirect, and short-term. Small volume spills are more likely to occur and would have localized impacts on water quality. In the unlikely event an allision or collision involving project vessels or components resulted in a large spill, impacts on water quality would be direct and indirect, adverse, and short-term to long-term, depending on the type and volume of material released and the specific conditions (e.g., depth, currents, weather conditions) at the location of the spill. Impacts from spills during decommissioning would be similar in nature to construction, but smaller in magnitude because fewer vessels would be used.

Under normal operations, the WTGs and ESPs are self-contained and do not generate discharges except under extenuating circumstances. Therefore, during operations, if a spill of the most likely volume (90 to 440 gallons [341 to 1,666 liters]) did occur, localized impacts would be temporary and short-term due to dispersion in the surrounding waters. The impacts would vary depending on the spill size, type of material, and conditions at the location of the spill. The Draft EIS Table 3.2.2-3 presents a selection of potential spill-causing events and their calculated probabilities for an individual lease area.

Other chemicals would also be used at the offshore wind projects, including, but not limited to, grease, paints, and sulfur hexafluoride. While anti-fouling paint is not necessary on most parts of the WTG and ESP foundations, anti-fouling paint may be used at each foundation in the immediate area of the opening for the cable pull-in (within an approximately 4-foot [1.2-meter] diameter circle centered on the opening for the cable). A release of any of these small amounts of materials during construction or operation would be localized, short-term, and result in little change to water quality.

All future offshore wind projects would be required to comply with regulatory requirements related to the prevention and control of accidental spills administered by USCG and the Bureau of Safety and Environmental Enforcement (BSEE). Oil Spill Response Plans are required for each project and would provide for rapid spill response, clean-up, and other measures that would help to minimize potential impact on affected resources from spills.

The use of heavy equipment onshore could result in potential spills during use or refueling activities. Onshore construction and installation activities and associated equipment would involve fuel and lubricating and hydraulic oils (Draft EIS Section 3.2.2.3).

Trash and debris may be accidentally discharged from vessels supporting the construction, operation, and decommissioning of offshore wind projects, which are expected to be low probability events. BOEM assumes operator compliance with federal and international requirements for management of shipboard trash; such events also have a relatively limited spatial impact.

Accidental releases of fuel/fluids/hazardous materials (hazmat) and/or trash and debris may increase and would primarily occur during construction, but also during operations and decommissioning of offshore wind facilities. BOEM assumes all projects and activities would comply with laws and regulations to minimize releases.

In summary, due to the low likelihood of a spill occurring and the expected size of the most likely spill, the overall impact of accidental releases is anticipated to be both direct and indirect, localized, and short-term, resulting in little change to water quality.

Anchoring: Where future offshore wind activities overlap the water quality geographic analysis area, there would be increased anchoring of vessels during survey activities and during the construction, installation, maintenance, and decommissioning of offshore components. In addition, there could be increased anchoring/mooring of met towers or buoys. BOEM estimates that 86 acres (0.3 square kilometers [km^2]) of seabed would be disturbed by anchoring associated with future offshore wind activities and cause temporary increases in suspended sediment and turbidity levels. These disturbances would be local and limited to the anchorage area. High suspended sediment concentrations (between 45 and 71 milligrams per liter [mg/L]) already occur in Nantucket Sound due to natural tidal conditions, and increase during storms, trawling, and vessel propulsion. The intensity and extent of the additional sediment suspension effects would be less than that of new cable emplacement and would therefore be unlikely to have an incremental impact beyond the immediate vicinity. If multiple projects are undergoing construction during the same period, the impacts would be greater than for one project, and multiple areas would experience water quality impacts from anchoring but, due to the localized area for sediment plumes, the impacts would likely not overlap each other geographically.

Due to the current ambient conditions and the localized area of disturbances around each of the individual anchors, the overall impact of increased sediment and turbidity from vessel anchoring is anticipated to be indirect, adverse, localized, and short-term, resulting in little change to ambient water quality. Anchoring would not be expected to appreciably contribute to overall impacts on water quality.

New cable emplacement and maintenance: Emplacement of submarine cables would result in increased suspended sediments and turbidity. Using the assumptions in Table A-4, future offshore wind development would result in seabed disturbance of about 1,015 acres (4.1 km^2) during offshore cable installation and 875 acres (3.5 km^2) during inter-array installation. Sediment transport modeling was conducted for the Proposed Action; based on what is known about other offshore wind projects within the water quality geographic analysis area, the modeling results would likely also be applicable to these projects. The modeling results from pre-cable installation dredging show that sediment concentrations greater than 10-mg/L could extend up to 10 miles (16.1 kilometers) from the site and spread throughout the water column (Attachment F in Epsilon 2018b). These plumes typically settle within 3 hours but could persist in small areas (15 acres [60,702.8 m^2] or less) for 6 to 12 hours (Epsilon 2018b). Dredged material disposal could cause concentrations greater than 1,000 mg/L for a duration of less than 2 hours and a distance of approximately 3 miles (5 kilometers). It is expected that future offshore wind projects within the water quality geographic analysis area will use dredging only when necessary and rely on other cable laying methods for reduced impacts (such as jet plow or mechanical plow). The modeling results specific to cable installation indicate impacts would remain within the lower portion of the water column (from 0 to 9.8 feet [0 to 3 meters] above the seafloor), and the portion of the plume that could exceed 10 mg/L would likely only extend 656 feet (200 meters) from the impact area but could extend up to 1.2 miles in the water column (2 kilometers). While new cable emplacement would disturb bottom sediment and result in temporary increases in suspended sediment, these disturbances would either be limited to the emplacement corridor or fairly localized. The majority of potential impacts within the northeast lease areas resulting from cable laying activities would fall within the range of variability caused by tidal currents, storms, trawling, and vessel propulsion (MMS 2009).

Due to the current ambient conditions, localized areas of disturbances, and range of variability within the water column, the overall impacts of increased sediments and turbidity from cable emplacement and maintenance is anticipated to be localized, short-term and adverse, resulting in little change to ambient water quality. If multiple projects are being constructed at the same time (Table A-6), the impacts would be greater than those identified for one project and would likely not overlap each other geographically due to the localized natures of the plumes. New cable emplacement and maintenance activities would not be expected to appreciably contribute to overall impacts on water quality.

Port utilization: Future offshore wind development could include port expansion/modification that would lead to increased potential for water quality impacts resulting from accidental fuel spills or sedimentation during port use as a result of increased vessel traffic. Vessel traffic would peak during construction activities and decrease during operations, but increase again during decommissioning. In addition, any related port expansion and construction activities, including channel deepening, related to the additional offshore wind projects would add to increased suspension and turbidity in the coastal waters. The increased sediment suspension could be long-term depending on the vessel traffic increase. Construction activities would occur beginning in 2022 and continuing through 2030 (Table A-6); the overall impact on water quality from port utilization would primarily be limited to that timeframe. Following construction and moving into normal operations, vessel activity would decrease to near-baseline conditions. Vessel use during operation would consist of scheduled inspection and maintenance activities (an example schedule is provided in COP Volume I, Figure 4.3-1; Epsilon 2018a), with corrective maintenance as needed. Vessel activity would then increase again during decommissioning. This increase in traffic could result in suspension of sediments leading to turbidity increases and the potential for accidental discharges (such as trash, debris, fuels, and other liquids). During future project operations, the Vineyard Haven port would be utilized. Depending on the amount of use and associated vessel traffic, increased turbidity could occur.

Due to construction timeframes and decreased operational traffic, the overall impact of accidental spills and sedimentation during port utilization is anticipated to be localized, short- to long-term, and adverse resulting in little change to water quality. Port utilization would not be expected to appreciably contribute to overall impacts on water quality.

Presence of structures: Using the assumptions in Table A-4, it is anticipated that the expanded cumulative scenario would include up to 373 structures in the water quality geographic analysis area and could result in alteration of local water currents (Chakrabarti 1987; COP Volume III, Epsilon 2018a). A discussion on potential alteration of local water currents can be found in SEIS Section 3.4. These disturbances would be localized but, depending on the hydrologic conditions, have the potential to impact water quality through the formation of sediment plumes. In addition, future offshore wind activities would result in 317 acres (1.3 km^2) of impact from installation of foundations and scour protection, and 537 acres (2.2 km^2) of impact from hard protection for the offshore export cables and inter-array cables.

For offshore wind facilities in Europe, scour processes have been a concern due to the potential impacts on water quality through the formation of sediment plumes (Harris et al. 2011). However, European offshore wind facilities are generally located at shallower depths with tidally dominated currents. The Draft EIS discussed the scour potential for the proposed Project and predicted it to be significantly less due to the difference in local hydrodynamic forces (Draft EIS Section 3.2.2.3; COP Volume III, Section 2.1, Appendix III K; Epsilon 2018a). Significant scour is not expected in the water quality geographic analysis area even without scour protection due to the low current speeds and minimal seabed mobility in the WDA (Section 3.2.2, COP Volume II; Epsilon 2018a). Scouring processes are more prevalent in portions of the proposed OECC in shallower water where tidal current flow can have a greater effect, but the buried depth of cables would likely be below the mobile sand layer in hard and soft-bottomed areas. Where burial is not possible in hard-bottom areas, the addition of cable armoring and the coarseness of the local sediment are anticipated to prevent scour (COP Volume III, Section 3.2.1 and 3.2.2, Appendix III-K; Epsilon 2018a). BMPs would be in place to mitigate scour, which would minimize impacts on water quality and facilitate return to baseline conditions following construction; therefore, no long-term water quality impacts are expected. This scour protection would be removed during decommissioning, which would lead to sediment resuspension from vessel activity and bottom disturbance. However, the disturbance is expected to be less than that which would occur during construction because there is no cause for disturbance along the OECC. The disturbance associated with decommissioning would occur regularly over a 7-10 year period for the various offshore wind projects, but would be localized and temporary due to hydrodynamic forces in the area and would quickly return to baseline conditions.

Due to the use of BMPs and the low scour potential, the overall impact of changes in local water currents and sedimentation from presence of structures is anticipated to be adverse, interim over the life of the offshore wind projects, and localized, resulting in little change to water quality. Presence of structures would not be expected to appreciably contribute to overall impacts on water quality.

Discharges: As stated in SEIS Section 3.13, future offshore wind projects would result in a small incremental increase in vessel traffic, with a short-term peak during construction. Vessel activity associated with future offshore wind project construction is expected to occur regularly in the WDA beginning in 2022 and continuing through 2030, and then lessen to near-baseline levels during operation. Increased vessel traffic would be localized near affected ports and offshore construction areas. Future offshore wind development would result in an increase in regulated discharges from vessels, particularly during construction and decommissioning, but the events would be staggered over time and localized. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. BOEM assumes that all vessels operating in the same area will comply with federal and state regulations on effluent discharge. All future offshore wind projects would be required to comply with regulatory requirements related to the prevention and control of discharges and the prevention and control of nonindigenous species. All vessels would need to comply with the USCG ballast water management requirements outlined in 33 CFR Part 151 and 46 CFR Part 162. Furthermore, each project's vessels would need to meet USCG bilge water regulations outlined in 33 CFR Part 151, and allowed vessel discharges such as bilge and ballast water would be restricted to uncontaminated or properly treated liquids. Therefore, due to the minimal amount of allowable discharges from vessels associated with future offshore wind projects, BOEM expects that impacts on water quality resulting from vessel discharges to be minimal and not exceed background levels over time.

One active ocean dredged material disposal site is in the area, which could be used for ocean dumping/dredge disposal. Impacts on water quality from ocean disposal would be minimized because approval for dredge disposal is regulated by the U.S. Army Corps of Engineers (USACE) and the USEPA enforces spoil criteria for permits issued by the USACE. If dredged material disposal occurs, sediment suspension would occur above baseline levels on a localized and short-term basis.

Due to the staggered increase in vessels from various projects, current regulatory requirements administered by the USEPA, USACE, USCG, and BSEE, and restricted allowable discharges, the overall impacts of discharges from vessels is anticipated to be indirect, localized, short-term and adverse. Based on the above, the level of impact in the water quality geographic analysis area from future offshore wind development would be similar to existing conditions and would not be expected to appreciably contribute to overall impacts on water quality.

Land disturbance: Future offshore wind development could include onshore components that would lead to increased potential for water quality impacts resulting from accidental fuel spills or sedimentation during the construction and installation of onshore components (e.g., equipment, substation). Construction and installation of onshore components that are near waterbodies may involve ground disturbance, which could lead to unvegetated or otherwise unstable soils. Precipitation events could potentially erode the soils, resulting in sedimentation of nearby surface waters and subsequent increased turbidity. Erosion and sedimentation controls would likely be implemented during the construction period to minimize impacts and resulting in infrequent and temporary erosion and sedimentation events.

In addition, onshore construction and installation activities would involve the use of fuel and lubricating/hydraulic oils (Draft EIS Section 3.2.2.3). Use of heavy equipment onshore could result in potential spills during active use or refueling activities. It is assumed that a Spill Prevention, Control, and Countermeasure Plan would be prepared for each project in accordance with applicable regulatory requirements, and would outline spill prevention plans and measures to contain and cleanup spills if they were to occur. Additional mitigation and minimization measures (such as refueling away from wetlands, waterbodies, or known private or community potable wells) would be in place to decrease impacts on coastal water quality. Impacts on water quality would be limited to periods of onshore construction and periodic maintenance over the life of each project.

Overall, the impacts from onshore activities that occur near waterbodies could result in temporary introduction of sediments or fluids into coastal waters in small amounts where erosion and sediment controls fail. Land disturbance for future offshore wind developments that are located at a distance from waterbodies and that implement erosion and sediment control measures would be less likely to impact water quality. In addition, the impacts would be localized to areas where onshore components were being built near waterbodies. While it is possible that multiple projects could be under construction at the same time, the likelihood that construction of the onshore components overlaps in time or space is minimal, and the total amount of erosion that occurs and impacts on water quality at any one given time could be minimal. Land disturbance from future offshore wind development is anticipated to be indirect, localized, short-term, and adverse and would not be expected to appreciably contribute to overall impacts on water quality.

A.8.2.1.2 Conclusions

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impacts on water quality. BOEM expects ongoing activities and future offshore wind activities to have temporary impacts on water quality primarily through accidental releases, increased anchoring, new cable emplacement and/or maintenance, port utilization, presence of structures, discharges, and land disturbance.

Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in **minor** adverse impacts due to cable emplacement and maintenance, port utilization, presence of structures, and discharges. These activities affect offshore water quality through either sediment suspension and turbidity or potential spill and marine debris risks. Construction and decommissioning activities associated with future offshore wind activities would lead to temporary and localized increases in sediment suspension and turbidity in the WDA during the first 6 to 10 years of construction of projects and in the latter part of the 30-year life spans of offshore wind projects due to decommissioning activities. However, based on ambient conditions and the results of modeling (Epsilon 2018b), the turbidity increases projected from construction are not expected to exceed the present baseline conditions in the northeast lease areas, and the amount of turbidity in the area would be similar to preexisting conditions.

Under the No Action Alternative, an increase in vessel traffic associated with offshore construction, operations, maintenance, and decommissioning of the future offshore wind projects in the water quality geographic analysis area may result in an increase of vessel traffic within the area. During the construction period for an individual project (estimated to be 2 years), an average of 25 and a maximum of 46 vessels may be present in the WDA or OECC—this could occur for an estimated 6 to 10 projects. Vessel activity associated with construction of these projects is expected to occur regularly in the WDA beginning in 2022 and continuing through 2030, and then lessen to near-baseline levels during operation activities. This increase would not lead to long-term alterations to water quality within the coastal and offshore waters because the hydrodynamic forces within the WDA lead to efficient dispersion of suspended sediments. The potential impacts from all of these activities would be minimized through the regulations administered by the USEPA, USACE, USCG, and BSEE.

A.8.2.2. Proposed Action and Action Alternatives

A.8.2.2.1 Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on water quality were described in Draft EIS Section 3.2.2.3, and additional information is included in Table A-8. The Proposed Action would likely result in localized impacts and would not alter the overall character of water quality in the water quality geographic analysis area. The Proposed Action would contribute to impacts through all of the IPFs named in Section A.8.2.1.1. The most impactful IPFs would likely include new cable emplacement/maintenance that could cause noticeable temporary impacts during construction through increased suspended sediments and turbidity, the presence of structures that could result in alteration of local water currents and lead to the formation of sediment plumes, and discharges that could result in localized turbidity increases during discharges or bottom disturbance during dredge material disposal. Other IPFs would likely contribute impacts of lesser intensity and extent, primarily during construction, but also during operations and decommissioning (Table A-8).

One IPF in Table A-8 was not discussed previously in the Draft EIS sections regarding water quality. Impacts from anchoring were only discussed in Draft EIS Section 3.3.5.3. Subsequent to publication of the Draft EIS, BOEM decided to assess specifically the potential impacts of anchoring on water quality. Anchoring primarily during the course of the construction and decommissioning of the proposed Project would increase turbidity levels around the anchor due to bottom disturbance and could occur during operations if anchoring is used.

Changes to the design capacity of the WTGs proposed in the Vineyard Wind COP (Epsilon 2020), as compared to the WTGs evaluated in the Draft EIS, would not alter the maximum potential water quality impacts for the Proposed Action and all other action alternatives because the maximum-case scenario involved the maximum number of WTGs (100) allowed in the PDE. Changes to the proposed onshore substation site could modify the impacts of the Proposed Action and all other action alternatives on water quality; however, the expansion area does not appear to be located within any U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory mapped wetlands and/or streams, and impacts would likely be **negligible** with implementation of BMPs or mitigation measures during construction.

The cumulative impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are listed by IPF in Table A-8. The nature of the primary IPFs and of potential impacts on water quality is described in detail in Section A.8.2.1.1.

The cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities would be similar to those described in Section A.8.2.1.1 but may differ in intensity and extent. As described in SEIS Chapter 3, BOEM assumes that the impacts on resources with a “restricted” geographic analysis area, such as water quality, would not be equal with or without the Proposed Action. In the absence of the Proposed Action, BOEM assumes that the total generating capacity of offshore wind facilities in the geographic analysis area would be 3,526 MW, 800 MW less than if the Proposed Action were approved.

Accidental Releases: Impacts on water quality as a result of accidental releases are described in Section A.8.2.1.1. The Proposed Action would have a maximum of 5,046 gallons (19,101 liters) of oils, lubricants, diesel fuel, and coolant per turbine (504,600 gallons [1.9 million liters] total), and a maximum of 129,301 gallons (489,458 liters) for 800 MW ESP storage (Epsilon 2020). As discussed previously, the risk of a spill from any single structure would be low and any effects would likely be localized. A reduction in the number of WTGs required due to increased capacity would result in a smaller total amount of materials being stored offshore. Modeling conducted for an area near the proposed Project area indicates that the most likely type of spill (i.e., non-routine event) to occur during the life of a project is 90 to 440 gallons (341 to 1,666 liters), which would have brief, localized impacts on water quality (Bejarano et al. 2013). The incremental impacts of the Proposed Action on water quality from accidental releases would be direct and indirect, localized, short-term, and **minor**.

COP Appendix I-A includes a draft Oil Spill Response Plan (Volume I; Epsilon 2018a), which the Proposed Action would implement. In the unlikely event an allision or collision involving project vessels or components resulted in a large spill, impacts on water quality would be direct and indirect, short-term to long-term, and **minor** to **moderate** depending on the type and volume of material released and the specific conditions (e.g., depth, currents, weather conditions) at the location of the spill. However, this scenario would be unplanned and is unlikely to occur; therefore, it has not been considered in the cumulative effects analysis for each of the alternatives discussed below. Cumulatively, there would be up to about 196,689 gallons (744,549 liters) of coolants, 2,436,789 gallons (9.2 million liters) of oils and lubricants, and 398,613 gallons (1.5 million liters) of diesel fuel contained within the 475 foundations between the Proposed Action and future offshore projects in the water quality geographic analysis area. The cumulative impacts on water quality from accidental releases associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities is anticipated to be both direct and indirect, short-term, and **minor** due to the low risk and the localized nature of the most likely spills, and the use of an Oil Spill Response Plan for projects. These impacts would occur primarily during construction, but also during operation and decommissioning to a lesser degree.

Anchoring: There would be increased vessel anchoring over 4 acres during survey activities and during the construction, installation, maintenance, and decommissioning of offshore components of the Proposed Action. Anchoring would cause increased turbidity levels. The proposed Project's incremental impacts on water quality from anchoring would be direct, localized, short-term, and **minor** during construction and decommissioning. Anchoring during operation would decrease due to fewer vessels required during operation, resulting in **negligible** incremental impacts. The Proposed Action's incremental contribution of an average of 25 and a maximum of 46 vessels during construction, and 4 acres (0.02 km^2) of impact from anchoring, would be additive with the impact(s) of any and all other anchoring activities, including offshore wind activities that occur within the water quality geographic analysis area during the same timeframe, resulting in a total of 90 acres (0.36 km^2) of seabed impact from anchoring.

The cumulative impacts on water quality from increased turbidity and sedimentation due to anchoring associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities is anticipated to be indirect, localized, and short-term, resulting in **minor** impacts on water quality, primarily during construction and decommissioning. During operations, cumulative impacts on water quality from anchoring associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be indirect, localized, short-term, and **negligible**.

New cable emplacement and maintenance: Installation of the Proposed Action OECC would mostly be done by jet or mechanical plow. Modeling showed that the resultant sediment plume is predicted to stay in the bottom 10 feet (3 meters) of the water column. Details on sedimentation caused by pre-cable installation dredging and cable installation itself are discussed in Section A.8.2.1.1. Vineyard Wind expects to use dredging only when necessary in sand wave areas, and not at all within Lewis Bay. A predicted maximum of 3.8 miles (6.1 kilometers) of dredging may occur in the OECC (Table 1-5 in Epsilon 2018b). A total of 117 acres (0.47 km^2) of seabed would be disturbed for offshore cable emplacement and 204 acres (0.82 km^2) would be affected during inter-array cable installation.

Sediment transport modeling was conducted for the Proposed Action to determine the potential extent, timing, and depth of sediment plumes. Modeling results of pre-cable installation dredging show that sediment concentrations greater than 10 mg/L could extend up to 10 miles (16.1 kilometers) from the site and spread throughout the water column (Attachment F in Epsilon 2018b). These plumes typically settle within 3 hours but could persist in small areas (15 acres [60,702.8 m^2] or less) for 6 to 12 hours (Epsilon 2018b). Dredged material disposal could cause concentrations greater than 1,000 mg/L for less than 2 hours and a distance of about 3 miles (5 kilometers). The modeling results specific to cable installation indicate impacts would remain within the lower portion of the water column (from 0 to 9.8 feet [0 to 3 meters] above the seafloor), and the portion of the plume that could exceed 10 mg/L would likely only extend 656 feet (200 meters) from the impact area, but could extend up to 1.2 miles (2 kilometers) in the water column. Overall, the footprint of potential impacts on water quality from cable installation would be less by using jetting than by using mechanical dredging due to the amount of material that would be dredged and subsequently placed or disposed of elsewhere (Epsilon 2018a). However, as there are multiple methods that may be used for new cable emplacement and maintenance for the Proposed Action, it is difficult to precisely model the sediment plumes that would be caused by these activities and the plumes' resultant impacts on water quality. Although turbidity is likely to be high in the affected areas, impacts on water quality decrease considerably as the sediment settles.

The proposed Project's incremental impacts on water quality from cable emplacement, due to suspension of sediment and resulting turbidity would be direct, short-term, and **minor**. The Project's incremental contribution to increased sediment concentration and turbidity would be additive with the impact(s) of any and all other cable installation activities, including offshore wind activities, that occur within the water quality geographic analysis area and that would have overlapping timeframes during which sediment is suspended. As such, the total cumulative impact would result in 1,132 aces (4.6 km^2) of impact for offshore cable installation and 1,079 acres (4.4 km^2) of impact for inter-array cable installation. The cumulative impacts on water quality from increased turbidity and sedimentation due to new cable emplacement and maintenance associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are anticipated to be short-term, resulting in **minor** to **moderate** impacts. There could be limited overlap in construction schedules for cable installation for the proposed Project and the South Fork Wind Project in 2022 with additional future offshore wind construction overlap occurring in 2023 and 2024. These impacts would not occur during operation.

Port utilization: The current bearing capacity of existing ports was considered suitable for wind turbines, requiring no port modifications for supporting offshore wind energy development (DOE 2014). During the proposed Project operations, the Vineyard Haven port would be utilized. No port expansion activities are anticipated for the Proposed Action. The incremental increases in ship traffic at the ports would be small and multiple authorities regulate water quality impacts from these operations (BOEM 2019a). Therefore, the incremental impacts of the Proposed Action on water quality from port utilization would be **negligible**.

Due to the lack of need for port modifications or expansions and the small increase in ship traffic, the overall cumulative impact on water quality from port utilization associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities is anticipated to be indirect, localized, short-term, and **negligible**.

Presence of structures: Impacts on water quality from the presence of structures are described in detail in Section A.8.2.1.1. Existing stationary facilities that present allision risks are limited in the open waters of the geographic analysis area and include the five offshore wind turbines associated with Block Island Wind Farm. Dock facilities and other structures are concentrated along the coastline. Using the assumptions in Table A-4, the expanded cumulative scenario would include up to 475 structures on the OCS and could result in alteration of local water currents (Chakrabarti 1987; COP Volume III, Epsilon 2018a). The Proposed Action would add up to 102 stationary structures to the WDA during construction, which would remain in place during operations. The proposed Project would contribute 53 acres (0.21 km^2) of impact for foundation and scour protection installation and 35 acres (0.14 km^2) of impact for hard protection for offshore cables to those totals. Under the cumulative scenario, future offshore wind activities including the Proposed Action would result in 369 acres (1.5 km^2) of impact from installation of foundations and scour protection, and 348 acres (1.4 km^2) of impact from hard protection for offshore cables. The proposed Project's incremental contribution to impacts on water quality due to the presence of structures would be additive with the impact(s) of any and all structures, including those of offshore wind activities, that occur within the water quality geographic analysis area and that would remain in place during the life of the proposed Project. These disturbances would be localized but, depending on the hydrologic conditions, have the potential to impact water quality through the formation of sediment plumes. Significant scour is not expected even without scour protection due to the low current speeds and minimal seabed mobility in the WDA (Section 3.2.2, COP Volume II; Epsilon 2018a). The addition of scour protection would further minimize effects on local sediment transport. The incremental impacts of the Proposed Action on water quality due to the presence of structures would be **negligible** during construction and decommissioning, and direct and indirect, long-term, and **minor** during operations. The cumulative impact on water quality from the alteration of water currents and increased sedimentation from structure placement associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities is anticipated to be constant over the lifespans of the projects, direct, localized, and **minor**, mostly during operations, but **negligible** during construction and decommissioning.

Discharges: During construction of the Proposed Action, an average of 25 and a max of 46 vessels may be present in the WDA, leading to potential discharges of uncontaminated water and treated liquid wastes. The proposed Project's incremental contribution to impacts on water quality due to discharges would be additive with the impact(s) of any and all discharges, including those of offshore wind activities, that occur within the water quality geographic analysis area during the same timeframe. Discharge events would mostly be staggered over time and localized, and all vessels would be required to comply with regulatory requirements related to prevention and control of discharges, accidental spills, and nonindigenous species administered by the USEPA, USACE, USCG, and BSEE. As such, the incremental impacts on water quality from the Proposed Action would be direct, short-term, and **minor** during construction and, to a lesser degree, during decommissioning. During operations, the number of vessels in use would decrease even more, resulting in **negligible** incremental impacts.

The cumulative impact on water quality from discharges associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities is anticipated to be direct and indirect, short-term, and localized, resulting in **minor** impacts, primarily during construction and to a lesser extent during decommissioning, due to the low likelihood of overlapping locations and timeframes, as well as regulatory requirements. During operations, cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities on water quality would be indirect, localized, short-term, and **negligible.**

Land disturbance: Impacts on water quality that could result from land disturbance are described in Section A.8.2.1.1. Construction of the substation onshore would lead to an increased potential for water quality impacts resulting from accidental fuel spills or sedimentation in waterbodies. The incremental increases in land disturbance from the Proposed Action would be small and mitigation measures, such as the use of a Spill Prevention, Control, and Countermeasure Plan, would be implemented. As such, the incremental impacts of the Proposed Action on water quality from land disturbance would be **minor**. The cumulative impact on water quality from land disturbance associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities is anticipated to be indirect, localized, and short-term, resulting in **minor** impacts due to the low likelihood that construction on onshore components would overlap in time or space, and the amount of erosion into nearby waterbodies would be minimal.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from **negligible** to **moderate**. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in **minor** impacts on water quality in the analysis area. The main drivers for this impact rating are the short-term, localized effects from increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operations due to the presence of structures. BOEM has considered the possibility of a

moderate impact resulting from accidental releases; this level of impact could occur if there was a large-volume, catastrophic, release. While it is an impact that should be considered, it is unlikely to occur. The Proposed Action would contribute to the overall impact rating primarily through the increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operation due to the presence of structures. Thus, the overall cumulative impacts on water quality would qualify as **minor** because adverse and measurable impact is anticipated, but the impact would be small and the resource would recover completely without remedial or mitigating action. The Proposed Action would contribute to, but does not change, this overall impact rating, primarily through the short-term and localized nature of the impacts.

A.8.2.2.2 Cumulative Impacts of Alternatives B, C, D1 and D2 and E

The direct and indirect impacts of Alternatives B, C, D, and E on water quality are described in Draft EIS Sections 3.2.2.4, 3.2.2.5, 3.2.2.6, and 3.2.2.7. Alternative B would narrow the PDE to include only the Covell's Beach landfall and reduce the impacts associated with the maximum-case scenario under the Proposed Action, due to the shorter OECC and the avoidance of Lewis Bay. Alternative C would relocate six of the northern-most WTGs and associated inter-array cables to the southern portion of the WDA. While the incremental impacts of Alternative C would be similar to those of the Proposed Action, additional site characterization surveys may cause local temporary impacts that are difficult to detect. Alternatives D1 and D2 would increase the size of the WDA and require different navigation routes for vessels in the WDA. Additional site characterization surveys may cause local temporary impacts that are difficult to detect. Adjusting the spacing between WTGs for Alternatives D1 and D2 to achieve wider spacing between WTGs would reduce the likelihood of collisions and allisions within the WDA, minimizing the potential for spills. Accordingly, the incremental impacts for Alternatives D1 and D2 from accidental releases are anticipated to be lower than the predicted incremental impacts from the Proposed Action. However, the impacts of a spill, should it occur, would be the same. Alternative E would reduce the number of turbines constructed to 84 WTGs. The impacts of construction, operations, maintenance, and decommissioning of Alternative E on water quality would be incrementally less than the Proposed Action as the reduction in WTGs would reduce the amount of seafloor disturbance, reduce the likelihood of a vessel allision, reduce the amount of chemicals and oils stored offshore, and result in fewer annual maintenance transfers. Additional site characterization surveys may cause local temporary impacts that are difficult to detect. The incremental impacts of this alternative would be similar, but slightly less than those of the Proposed Action. Alternatives B, C, D, and E would not result in additional impact on water resources, such as wetlands and waterbodies, for the proposed substation site compared to the Proposed Action. Therefore, the incremental impacts of these alternatives on water quality would be the same as, or less than, those of the Proposed Action. Alternatives B, C, D, and E would have **negligible** to **minor** impacts resulting from individual IPFs on water quality (due to the IPFs discussed above) with Alternative B avoiding some impacts due to a short OECC route but still resulting in the same impact level.

The cumulative impacts resulting from individual IPFs associated with Alternatives B, C, D1, D2, and E would be very similar to those of the Proposed Action, as discussed in the preceding paragraphs, with individual IPFs leading to impacts ranging from **negligible** to **moderate.** The overall cumulative impacts of Alternatives B, C, D1, D2, and E when combined with past, present, and reasonably foreseeable activities on water quality would be the same level as under the Proposed Action—**minor**. This impact rating is driven mostly by short-term, localized effects from increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operations due to the presence of structures.

A.8.2.2.3 Cumulative Impacts of Alternative F

Alternative F analyzes a vessel transit lane through the WDA, in which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. Under this alternative, BOEM is analyzing a 2- and 4-nautical-mile northwest/ southeast vessel transit lane through the WDA combined with any action alternative; however this analysis focuses on the combination of Alternative F with either the Proposed Action or Alternative D2 layout. Therefore, the number of turbines would remain the same. The northern transit lane within the WDA could result in the relocation of 16 to 34 WTGs and a 12 to 61 percent increase in the size of the WDA, and therefore, a likely increase in the amount of inter-array cables. As stated previously, the geographic analysis area for water quality extends for a 10-mile (16.1 kilometer) radius around the WDA, the OECC, and vessel approach routes to port facilities that would be used by the proposed Project. As a result, and because WTGs would be relocated further south of the WDA as a result of the transit lane, Alternative F in combination with any other alternative or combination of alternatives would expand the area of potential effect for water quality. The direct and indirect impacts of Alternative F on water quality would be slightly less than the Proposed Action because the transit lanes would reduce potential impacts from accidental releases related to vessel collisions or allisions with WTGs. Impacts from other IPFs would remain the same as or substantially similar to those of the Proposed Action. Alternative F would not result in additional impacts on water resources, such as wetlands and waterbodies, for the proposed substation site compared to the Proposed Action. As a result, Alternative F would have direct and indirect, **negligible** to **minor** impacts on water quality. The direct and indirect impacts from the combination of the new Alternative F with Alternative A or Alternative D2 is expected to be similar to combinations with the other alternatives. Consequently, these other potential combinations are not separately analyzed here.

In considering the cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities, BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The cumulative impacts of Alternative F would be very similar to the cumulative impacts under the Proposed Action (with individual IPFs leading to impacts ranging from **negligible** to **minor** impacts); however, there could be an increase in suspended sediment concentration and turbidity as a result of the WTGs shifting further south, which would require more inter-array cabling to span a 2- or 4-nautical mile transit lane. The overall cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities on water quality would be the same level as under the Proposed Action—minor. This impact rating is driven mostly by short-term, localized effects from increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operation due to the presence of structures.

BOEM has qualitatively evaluated the cumulative impacts of implementing all six RODA-recommended transit lanes, including the northern transit lane described for Alternative F, as well as five other transit lanes through the RI and MA Lease Areas. As discussed in SEIS Section 3.4.2, if all the proposed transit lanes were implemented, this would not allow the technical capacity of offshore wind power generation assumed in SEIS Chapter 1 to be met. To the extent additional transit lanes are implemented in the future outside the WDA as part of RODA's suggestion, the placement of these additional transit lanes could require longer vessel trips for all phases of future projects (construction, operations, maintenance, and decommissioning). As would be the case for the proposed Project, other project infrastructure located further from shore could also require and longer timeframes time for cable installation. These effects could result in more water quality impacts overall due to increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operation due to the presence of structures.

A.8.2.2.4 Comparison of Alternatives

The Proposed Action would result in direct, short-term, minor incremental impacts on water quality from accidental releases of small quantities (90 to 440 gallons [341 to 1,666 liters]), anchoring during construction and decommissioning, cable emplacement, and discharge events. Indirect, short-term, minor incremental impacts on water quality would occur due to land disturbance. The presence of structures during operation would result in direct and indirect, long-term, minor incremental impacts on water quality, while an accidental release of large volume (i.e., catastrophic release of at least 128,000 gallons [484,32 liters]) would result in direct and indirect, short-term to long-term, and minor to moderate incremental impacts on water quality. Anchoring during operations, port utilization throughout the proposed Project lifecycle, and the presence of structures during construction and decommissioning would result in negligible incremental impacts on water quality.

Anchoring, cable emplacement and maintenance, the presence of structures, and other IPFs of the Proposed Action, when combined with past, present, and reasonably foreseeable activities, could result in cumulative impacts whenever activities occur within the water quality geographic analysis area or overlap in time. Accidental releases, anchoring, new cable emplacement and maintenance, port utilization, discharges, and land disturbance are expected to lead to short-term and localized impacts. The presence of structures would lead to long-term impacts. Cumulative impacts under any of the action alternatives would likely be similar, negligible to minor, because the majority of the cumulative impacts of any one alternative would be associated with other future offshore wind development, which does not change between alternatives. The overall cumulative impacts of any alternative when combined with past, present, and reasonably foreseeable activities would be minor which is largely driven by short-term, localized effects from increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operations due to the presence of structures.

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Table A-8: Summary of Activities and the Associated Impact-Producing Factors for Water Quality

Baseline Conditions: Impacts on water quality in waters of the geographic analysis area for water quality within the Northeastern Atlantic include terrestrial runoff, terrestrial point source discharges, and atmospheric deposition. Additional activities that impact the water quality condition include urbanization; forestry practices; municipal waste discharges; agriculture; marine vessel traffic-related discharges; wastewater; persistent contaminants and marine debris; dredging and marine disposal; bridge and coastal road construction; commercial fishing; recreation and tourism; harbor, port, and terminal operations; military and NASA operations; renewable energy development; natural events; and climate change.

Water temperature, salinity, DO, pH, chlorophyll a, turbidity, and nutrient levels are the key parameters characterizing ocean water quality, and contribute to the latter's ability to support and maintain a healthy ecosystem. Some of these parameters are accepted proxies for ecosystem health (e.g., DO, nutrient levels), while others delineate coastal habitats from marine habitats (e.g., temperature, salinity). Northeastern coastal waters are experiencing a long-term warming trend; average temperatures from 1980 to 2005 are 0.5 to 1.3°C warmer than average temperatures from 1890 to 1905. Increased coastal development on Cape Cod is causing increased nutrient pollution in communities, approximately 80 percent of which is due to groundwater contamination by septic systems. Both development and increased boat traffic contribute to other contaminant levels.

For additional information on water quality baseline conditions see Draft EIS Section 3.2.2.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/ hazmat	Accidental releases of fuels and fluids occur during vessel usage for dredge material ocean disposal, fisheries use, marine transportation, military use, survey activities, and submarine cable, lines, and pipeline laying activities. According to the DOE, 31,000 barrels (4.9 million liters) of petroleum are spilled into U.S. waters from vessels and pipelines in a typical year. Approximately 40.5 million barrels (6.4 billion liters) of oil were lost as a result of tanker incidents from 1970 to 2009, according to International Tanker Owners Pollution Federation Limited, which collects data on oil spills from tankers and other sources. From 1990 to 1999, the average annual input to the coastal Northeast was 220,000 barrels of petroleum and into the offshore was <70,000 barrels. Impacts on water quality would be expected to brief and localized from accidental releases.	Future accidental releases from offshore vessel usage, spills, and consumption will likely continue on a similar trend. Impacts are unlikely to affect water quality.	Using the assumptions in Table A-4, if all leased areas within the water quality geographic analysis area are built out, there is a low risk of leak from any of the approximately 364 WTGs and 9 ESPs. Each WTG would contain approximately 1,717 gallons (6,500 liters) of transformer oil, approximately 2,113 gallons (8,000 liters) of general oil (for hydraulics and gearboxes), and approximately 423 gallons (1,601 liters) of coolants. Each ESP would contain up to approximately 123,559 gallons (467,720 liters) of oil and lubricants and approximately 46 gallons (174 liters) of coolants. The total quantity of diesel fuel for all WTGs and ESPs within the water quality geographic analysis area would be approximately 313,617 gallons (1.2 million liters). Total fuel/fluids/hazmat on Atlantic offshore wind facilities would be approximately 2,398,190 gallons (9.1 million liters). WTGs and ESPs would be equipped with secondary containment sized according to the largest oil chamber. The use of heavy equipment onshore could result in potential spills during use or refueling activities. Onshore construction and installation activities and associated equipment would involve fuel and lubricating and hydraulic oils. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities. The impact of accidental releases is anticipated to be short-term, localized, and result in little change to water quality.	The Proposed Action would have a maximum of 5,046 gallons (19,101 liters) of oils, lubricants, diesel fuel, and coolant per turbine (504,600 gallons [1.9 million liters] total), and a maximum of 129,301 gallons (489,458 liters) for 800 MW ESP storage (Epsilon 2020). Modeling near the proposed Project area indicates a low risk of a spill from any structure, and the most likely type of spill (i.e., non-routine event) to occur during the life of the Proposed Action is 90 to 440 gallons (341 to 1,666 liters), which would have brief, localized impacts on water quality. Small releases would have minor impacts, while a larger spill, although unlikely to occur, could have minor to moderate impacts.	The impacts on water quality from this sub-IPF under the Proposed Action could include potential accidental releases of fuels and fluids primarily during construction, but also throughout operations. Small releases would have minor impacts, while a larger spill, although unlikely to occur, could have minor to moderate impacts. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature but a greater spatial and temporal extent. Future offshore wind activities excluding the proposed Project would likely be of a similar nature, spatial, and temporal extent. Cumulatively, the impacts on water quality through this sub-IPF associated with the Proposed Action and past, present, and reasonably foreseeable activities would be both direct and indirect, localized, and short-term, resulting in minor impacts on water quality, primarily during construction but also during operation and decommissioning to a lesser degree. In the unlikely event an allision or collision involving project vessels or components resulted in a large spill, impacts on water quality would be direct and indirect, short-term to long-term, and minor to moderate depending on the type and volume of material released and the specific conditions (e.g., depth, currents, weather conditions) at the location of the spill.
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities, and cables, lines, and pipeline laying. Accidental releases of trash and debris are expected to be low probability events. BOEM assumes operator compliance with federal and international requirements for management of shipboard trash; such events also have a relatively limited spatial impact.	As population and vessel traffic increase gradually over the next 30 years, accidental release of trash and debris may increase. However, there does not appear to be evidence that the volumes and extents anticipated would have any effect on water quality.	Trash and debris may be released by vessels during construction, operations, and decommissioning. An accidental release would be a low probability event in the vicinity of project areas, likely resulting in little change to water quality.	The Proposed Action could result in release of trash and debris by vessels during construction, operations, and decommissioning. BOEM assumes all vessels would comply with laws and regulations to minimize releases. In the event of a release it would be an accidental, localized event in the vicinity of project areas, likely resulting in little change to water quality; therefore, the impacts would be negligible.	Trash and debris may be accidentally discharged as a result of the Proposed Action from vessels supporting the construction, operation, and decommissioning of offshore wind projects. Accidental releases of trash and debris are expected to be low probability events and therefore negligible impacts. BOEM assumes operator compliance with federal and international requirements for management of shipboard trash; such events also have a relatively limited spatial impact. Cumulatively, the impacts on water quality through this sub-IPF associated with the Proposed Action and past, present, and reasonably foreseeable activities would be direct, localized, short-term, and negligible.
Anchoring	Impacts from anchoring occur due to ongoing military use and survey, commercial, and recreational activities.	Impacts from anchoring may occur semi-regularly over the next 30 years due to offshore military operations or survey activities. These impacts would include increased seabed disturbance resulting in increased turbidity levels. All impacts would be localized, short-term, and temporary.	Under the assumptions in Table A-4, there would be increased anchoring during the construction and installation of offshore components and survey activities. In total, BOEM estimates approximately 86 acres (0.3 km^2) of seabed would be disturbed by anchoring associated with offshore wind activities. In addition, there would be increased anchoring/mooring from met towers or buoys associated with the expanded cumulative scenario. Impacts would include increased seabed disturbance resulting in increased turbidity levels. All impacts would be short-term and localized, occurring primarily during construction, but also during operations and decommissioning.	There would be increased vessel anchoring over 4 acres (0.02 km^2) during survey activities and during the construction, installation, maintenance, and decommissioning of offshore components (up to 100 WTGs and 2 ESPs) of the Proposed Action. During construction of the Proposed Action, an average of 25 and a max of 46 vessels may be present in the Project area leading to increased turbidity impacts from anchoring. All impacts, including increased turbidity and alteration of water quality, would be short-term and local, with minor impacts during construction and negligible during operations.	The impacts on water quality from this IPF under the Proposed Action could include increased turbidity levels primarily during construction, but also throughout operations. Impacts on water quality from anchoring would be direct, localized, short-term, and minor during construction and decommissioning. Anchoring during operation would decrease due to fewer vessels required during operation, resulting in negligible impacts. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature but a greater spatial and temporal extent. Future offshore wind activities excluding the proposed Project would likely be of a similar nature, spatial, and temporal extent. Cumulatively, the impacts on water quality through this IPF associated with the Proposed Action and past, present, and reasonably foreseeable activities would be indirect, localized, short-term, and negligible to minor.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
New cable emplacement/ maintenance	Suspended sediment concentrations between 45 and 71 mg/L can occur in Nantucket Sound under natural tidal conditions and increase during storms, trawling, and vessel propulsion. Survey activities, and new cable and pipeline laying activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances would be short-term and either be limited to the emplacement corridor or localized.	Suspension of sediments may continue to occur infrequently over the next 30 years due to survey activities, and submarine cable, lines, and pipeline-laying activities. Future new cables, perhaps connecting Martha's Vineyard and/or Nantucket to the mainland, would occasionally disturb the seafloor and cause short-term increases in turbidity and minor alterations in localized currents resulting in local short-term impacts. The FCC has two pending submarine tele-communication cable applications in the North Atlantic. If the cable routes enter the water quality geographic analysis area, short-term disturbance in the form of increased suspended sediment and turbidity would be expected.	Assuming similar installation procedures as the proposed Project, the duration and range of impacts would be limited and the water quality would recover following the disturbance. Under the cumulative scenario there would be 1,015 acres (4.1 km^2) of impact for offshore cable installation and 875 acres (3.5 km^2) of impact for inter-array cable installation. Impacts would occur during construction and would involve a temporary and localized increase in sediment suspension and turbidity for up to 12 hours at a time.	The Proposed Action submarine cable installation would mostly be done by jet or mechanical plow. The modeled resultant plume specific to cable installation is predicted to stay in the lower portion of the water column (bottom 9.8 feet). The portion of the plume that exceeds 10 mg/L typically would extend 656 feet from the route centerline but could extend up to 1.2 miles. Modeling also showed that sediment concentrations greater than 10 mg/L from pre-cable installation dredging could extend up to 10 miles (16 kilometers) from the route centerline and spread through the entire water column. These plumes typically settled within 3 hours but could persist in small areas (15 acres [60,702.8 m^2] or less) for up to 6 to 12 hours (Table 4.2-3, COP Volume 1, Epsilon 2018a). Dredged material disposal could cause concentrations greater than 1,000 mg/L for a duration of less than 2 hours and a distance of approximately 3 miles (5 kilometers). A predicted maximum of 3.8 miles (6.1 kilometers) of dredging may occur in the OECC (Table 1-5 in Epsilon 2018b). The footprint of potential impacts to water quality from cable installation would be less by using jetting rather than mechanical dredging, due to the amount of material that would be dredged and subsequently placed or disposed of elsewhere (Epsilon 2018a). Although turbidity is likely to be high in the affected areas, the sediment would not impact water quality once it has settled. The impacts on water quality from this IPF under the Proposed Action could include accidental suspension of sediments for up to 12 hours at a time throughout construction. However, as there are multiple methods that may be used for new cable emplacement and maintenance, it is difficult to precisely model the sediment plumes that would be caused by these activities and the plumes' resultant impacts on water quality. Based on the parameters used for this modeling effort, the impacts would be direct, short-term, and minor.	The impacts on water quality from this IPF under the Proposed Action could include accidental suspension of sediments for up to 6 hours at a time throughout construction. The impacts would be direct, short-term, and minor. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature but a greater spatial and temporal extent. Future offshore wind activities excluding the proposed Project would likely be of a similar nature, spatial, and temporal extent; if construction activities were occurring concurrently at two areas, these concentrations are unlikely to be exceeded. Cumulatively, the impacts on water quality through this IPF associated with the Proposed Action and past, present, and reasonably foreseeable activities would be direct and indirect and short-term, resulting in minor to moderate impacts during construction. These impacts would not occur during operation or decommissioning.
Port utilization: Expansion	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications, which, along with additional vessel traffic, could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long-term depending on the vessel traffic increase. However, the existing suspended sediment concentrations in Nantucket Sound are already 45-71 mg/L; therefore, impacts from vessel traffic are likely to be masked by the natural variability. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future.	The general trend along the coastal region from Virginia to Maine is that port activity will increase modestly over the next 30 years. Port modifications and channel deepening activities are being undertaken to accommodate the increase in vessel traffic and deeper draft vessels that transit the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. However, the existing suspended sediment concentrations in Nantucket Sound are already 45-71 mg/L, so impacts from vessel traffic are likely to be masked by the natural variability. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future.	Increases in port utilization due to other offshore wind energy projects will lead to an increased potential for an accidental spill and the release of trash and debris. This increase in vessel traffic will be at its peak during construction activities and will decrease during operations but will increase again during decommissioning. In addition, any related port expansion and construction activities related to the additional offshore wind projects would add to increased sediment suspension and turbidity in coastal waters.	The Proposed Action could result in increased port use during construction and decommissioning, which could affect water quality near ports. The Proposed Action would not result in any port expansion and therefore would not result in any additional affects to water quality near ports from port expansion. The impacts on water quality from this IPF under the Proposed Action could include accidental fuel spills or sedimentation during the use of the ports in Vineyard Haven, New Bedford, Montaup, Brayton Point, and Davisville. Impact would primarily occur during construction and decommissioning and would be negligible.	As previously stated, the impacts on water quality from this IPF under the Proposed Action could include accidental fuel spills or sedimentation during the increased use of the ports in Vineyard Haven, New Bedford, Montaup, Brayton Point, and Davisville. Impact would primarily occur during construction and decommissioning and would be negligible. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature but a greater spatial and temporal extent. Future offshore wind activities excluding the Proposed Action are expected to cause impacts through this sub-IPF on water quality that are less than noticeable. Cumulatively, the impacts on water quality through this IPF associated with the Proposed Action and past, present, and reasonably foreseeable activities would be indirect, localized, short-term, and negligible.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures	The installation of onshore and offshore structures leads to alteration of local water currents. These disturbances would be local but, depending on the hydrologic conditions, have the potential to impact water quality through the formation of sediment plumes.	See Draft EIS Appendix C, Section C.1.3 for activities. Impacts associated with the presence of structures includes temporary sediment disturbance during maintenance. This sediment suspension would lead to interim and localized impacts.	Using the assumptions in Table A-4, if all lease areas within the water quality geographic analysis area are built out, there would be approximately 475 structures (WTGs and ESPs). Future offshore wind activities would result in 317 acres (1.3 km^2) of impact from installation of foundations and scour protection, and 537 acres (2.2 km^2) of impact from hard protection for both the offshore export cables and inter-array cables within the water quality geographic analysis area. Scour potential would be dependent on current speeds and seabed mobility within the lease area (COP Volume III; Epsilon 2018a). The WTG and ESP foundations would result in localized alterations of water currents, but the low current speeds in the NE leasing areas and minimal seabed mobility would result in minimal concern over scour. Measures would be in place to minimize scour and therefore any sediment plumes would return to baseline conditions in the area with minimal impact.	The impacts on water quality from this IPF under the Proposed Action could include alteration of local water currents during the life of the Project. The Proposed Action would contribute 53 acres (0.21 km^2) of impact for foundation and scour protection installation and 35 acres (0.14 km^2) of impact for hard protection for offshore cables to those totals. Vineyard Wind would not expect significant scour even without scour protection due to the low current speeds and minimal seabed mobility in the WDA (Section 3.2.2, COP Volume II; Epsilon 2018a). The impacts on water quality would be direct and indirect, long-term, and minor during operations. The placement and removal of structures during construction and decommissioning, respectively, would result in temporary increases in turbidity, but would ultimately result in negligible impacts on water quality.	The impacts on water quality from this IPF under the Proposed Action could include alteration of local water currents during the life of the Project. Vineyard Wind would not expect significant scour even without scour protection due to the low current speeds and minimal seabed mobility in the WDA (Section 3.2.2, COP Volume II; Epsilon 2018a). The impacts on water quality would be direct and indirect, long-term, and minor during operations. The placement and removal of structures during construction and decommissioning, respectively, would result in temporary increases in turbidity, but would ultimately result in negligible impacts on water quality. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature but a greater spatial and temporal extent. Future offshore wind activities excluding the proposed Project would likely be of a similar nature, spatial, and temporal extent. Cumulatively, the impacts on water quality through this IPF associated with the Proposed Action and past, present, and reasonably foreseeable activities would be constant over the lifespans of the projects, direct, localized, and minor during operations. Placement and removal of the structures during construction and decommissioning, respectively, would result in localized turbidity, but would not affect water currents during the short timeframe of activity, resulting in negligible impacts.
Discharges	Discharges impact water quality by introducing nutrients, chemicals, and sediments to the water. There are regulatory requirements related to prevention and control of discharges, the prevention and control of accidental spills, and the prevention and control of nonindigenous species.	Increased coastal development on Cape Cod is causing increased nutrient pollution in communities, approximately 80 percent of which is due to groundwater contamination by septic systems. In addition, ocean disposal activity in the North and Mid-Atlantic is expected to gradually decrease or remain stable. Impacts of ocean disposal on water quality are minimized because USEPA has established dredge spoil criteria and regulate the disposal permits issued by USACE. The impact on water quality from sediment suspension during these future activities would be short-term and localized.	Offshore wind projects would result in increased potential for discharges from vessels during construction, operations, and decommissioning. Short-term and localized turbidity increases due to bottom disturbance would occur during structure placement. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. There would be an increase in these wastes, particularly during construction and decommissioning, but the disposal periods would be staggered over time and localized.	During construction of the Proposed Action, an average of 25 and a max of 46 vessels may be present in the Vineyard Wind 1 WDA leading to potential discharges of uncontaminated water and treated liquid wastes. All vessels would be required to comply with regulatory requirements related to prevention and control of discharges, the prevention and control of accidental spills, and the prevention and control of nonindigenous species. It is assumed that all vessels would comply with USCG ballast water management requirements and USCG bilge water regulations. Impacts on water quality would be direct, short-term, and minor during construction and, to a lesser degree, during decommissioning. During operations, the number of vessels in use would decrease even more, resulting in negligible impacts on water quality.	The impacts on water quality from this sub-IPF under the Proposed Action could include increased potential for discharges from vessels during construction, operations, and decommissioning and increased turbidity levels due to bottom disturbance for structure placement. Impacts on water quality would be direct, short-term, and minor during construction and, to a lesser degree, during decommissioning. During operations, the number of vessels in use would decrease even more, resulting in negligible impacts on water quality. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature but a greater spatial and temporal extent. Future offshore wind activities excluding the proposed Project would likely be of a similar nature, spatial, and temporal extent. Cumulatively, the impacts on water quality through this sub-IPF associated with the Proposed Action and past, present, and reasonably foreseeable activities would be direct and indirect, localized, and short-term, resulting in minor impacts, primarily during construction and to a lesser extent during decommissioning. During operation, cumulative impacts associated with the Proposed Action and past, present, and reasonably foreseeable activities on water quality would be indirect, localized, short-term, and negligible.
Land disturbance: erosion and sedimentation	Ground disturbance activities may lead to un-vegetated or otherwise unstable soils. Precipitation events could potentially mobilize the soils into nearby surface waters, leading to potential erosion and sedimentation effects and subsequent increased turbidity.	Ground disturbance associated with construction and installation of onshore components could lead to un-vegetated or unstable soils. Precipitation events could mobilize these soils leading to erosion and sedimentation effects and turbidity. The impacts for future offshore wind through this IPF would be staggered in time and localized. The impacts would be short term and localized with an increased likelihood of impacts limited to onshore construction periods.	Erosion and sedimentation can occur from multiple construction and decommissioning activities. The staggered nature of construction activities would limit the total erosion and sedimentation contribution to water quality at any given time.	Additional sediment suspension could occur during construction, outside those that are authorized. The intensity and extent of the effects are geographically constrained such that they are unlikely to have an incremental impact beyond an immediate project vicinity. With staggered construction events, the overall impact on water quality would be short-term, localized, and minimal. The impacts on water quality from this sub-IPF under the Proposed Action could include increased potential for erosion and sedimentation effects, and subsequently increased turbidity due to onshore ground disturbance activities that lead to un-vegetated or otherwise unstable soils that could be mobilized by precipitation events. Impacts would be direct and indirect, short-term, and minor.	The impacts on water quality from this sub-IPF under the Proposed Action could include increased potential for erosion and sedimentation effects, and subsequently increased turbidity, due to onshore ground disturbance activities that lead to un-vegetated or otherwise unstable soils that could be mobilized by precipitation events. Impacts would be direct and indirect, short-term, and minor. These impacts would occur periodically over the 3-year construction timeframe. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature but a greater spatial and temporal extent. Future offshore wind activities excluding the Proposed Action are expected to cause impacts through this sub-IPF on water quality that are less than noticeable. Cumulatively, the impacts on water quality through this sub-IPF associated with the Proposed Action and past, present, and reasonably foreseeable activities would be direct and indirect, short-term, and minor.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Land disturbance: Onshore construction	Onshore construction activities may lead to un-vegetated or otherwise unstable soils as well as soil contamination due to leaks or spills from construction equipment. Precipitation events could potentially mobilize the soils into nearby surface waters, leading to increased turbidity and alteration of water quality.	The general trend along coastal regions is that port activity will increase modestly in the future. This increase in activity includes expansion needed to meet commercial, industrial, and recreational demand. Modifications to cargo handling equipment and conversion of some undeveloped land to meet port demand would be required to receive the increase in larger ships.	The construction and installation of onshore components would lead to ground disturbance. This could include onshore infrastructure and land use requirements related to an increase in port activity required to meet the demands of future offshore wind. Ground disturbance and precipitation leads to mobilization of soils into nearby waters leading to erosion and sedimentation. Use of heavy equipment onshore could lead to potential spills and result in the inadvertent release of fluids from machinery. Erosion and sedimentation controls should minimize these impacts. The likelihood of these impacts is minimal and localized. They would be focused in areas with onshore construction and often areas where refueling occurs, which would have adequate response abilities.	Ground disturbance associated with onshore construction activities of the Proposed Action could lead to un-vegetated or otherwise unstable soils. Precipitation events could potentially mobilize the soils into nearby surface waters, leading to potential erosion and sedimentation effects and subsequent increased turbidity. Vineyard Wind would implement erosion and sedimentation controls during the construction period, making these potential effects temporary and localized. Impacts would be direct and indirect, short-term, and minor.	The impacts on water quality from this sub-IPF under the Proposed Action could include increased turbidity and alteration of water quality following precipitation events due to onshore construction activities that lead to un-vegetated or otherwise unstable soils and soil contamination due to leaks or spills from construction equipment. These impacts would occur periodically over the 3-year construction timeframe. Impacts would be direct and indirect, short-term, and minor. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature but a greater spatial and temporal extent. Future offshore wind activities excluding the Proposed Action are expected to cause impacts through this sub-IPF on water quality that are less than noticeable. Cumulatively, the impacts on water quality through this sub-IPF associated with the Proposed Action and past, present, and reasonably foreseeable activities would be direct and indirect, short-term, and minor.

BOEM = Bureau of Ocean Energy Management; DO = dissolved oxygen; DOE = U.S. Department of Energy; EIS = Environmental Impact Statement; ESP = electrical service platform; FCC = Federal Communications Commission; gal = gallon; IPF = impact-producing factors; L = liter; m2 = square meters; mg/L = milligrams per liter; NASA = National Aeronautics and Space Administration; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor; USACE = U.S. Army Corps of Engineers; USCG = U.S. Coast Guard; USEPA = Environmental Protection Agency; WDA = Wind Development Area; WTG = wind turbine generator

A.8.3. Birds

A.8.3.1. No Action Alternative Impacts

Table A-11 contains a detailed summary of the baseline conditions and the impacts of ongoing and future offshore activities other than offshore wind on birds, based on the IPFs assessed. The information comes primarily from the Draft EIS, supplemented by information developed in responding to comments on the Draft EIS, from the USFWS, and additional information. The impact analysis is limited to the impacts within the geographic analysis area for birds as described in Table A-1 and shown on Figure A.7-16.

Birds in the geographic analysis area are subject to pressure from ongoing activities, particularly accidental releases, new cable emplacement, interactions with fisheries and fisheries gear, and climate change. More than one-third of bird species that occur in North America (37 percent, 432 species) are at risk of extinction unless significant conservation actions are taken (NABCI 2016). This is likely representative of the conditions of birds within the geographic analysis area. The Northeastern United States is also home to more than one-third of the human population of the nation. As a result, species that live or migrate through the Atlantic Flyway have historically been, and will continue to be, subject to a variety of ongoing anthropogenic stressors, including hunting pressure (~86,000 sea ducks harvested annually [Roberts 2019]), fisheries by-catch (~2,600 seabirds killed annually on the Atlantic [Hatch 2017; Sigourney et al. 2019]), and climate change, that have the potential to have adverse impacts on bird species. Globally, monitored offshore bird populations have declined by nearly 70 percent from 1950 to 2010, which may be representative of the overall population trend of seabirds (Paleczny et al. 2015) including those that forage, breed, and migrate over the Atlantic OCS. Overall, offshore bird populations are decreasing; however, considerable differences in population trajectories of offshore bird families have been documented. Coastal birds, especially those that nest in coastal marshes and other low-elevation habitats, are additionally vulnerable to sea-level rise and the increasing frequency of strong storms as a result of global climate change. Models of vulnerability to climate change estimate that, throughout Massachusetts, 61 species (43 percent of the 143 species modeled) are highly vulnerable, and 22 species (15 percent) are likely vulnerable (Mass Audubon 2017), some of which occur in the geographic analysis area. These ongoing impacts on birds would continue regardless of the offshore wind industry.

Under the No Action Alternative, the proposed Project would not be built and hence would have no bird impact. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. If the Vineyard Wind 1 Project is not approved, then impacts from the proposed Project would not occur as proposed. However, the state demand that the Vineyard Wind 1 Project would have filled, if approved, could likely be met by other projects in the geographic analysis area for birds. Therefore, the impacts on birds would be similar, but the exact impact 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 and considers the assumptions included in this SEIS Section 1.2 and here in Appendix A. A detailed analysis of impacts associated with future offshore wind development is provided in Section A.8.3.1.1 and summarized in Table A-11. Cumulative impacts of the Proposed Action and action alternatives are analyzed in Section A.8.3.2.

A.8.3.1.1 Future Offshore Wind Activities (without Proposed Action)

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

Accidental releases: Accidental releases of fuel/fluids/hazmat, sediment, and/or trash and debris may increase as a result of future offshore wind activities. Section A.8.2 discusses the nature of releases anticipated. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities.

In the expanded cumulative scenario, there would be a low risk of a leak of fuel/fluids/hazmat from any single 1 of approximately 2,021 WTGs and 45 ESPs, each with approximately 5,000 gallons (18,927 liters) stored. Total fuel/fluids/hazmat on Atlantic offshore wind facilities would be approximately 17.6 million gallons (64.4 million liters) (20 percent of the capacity of a single super tanker). Ingestion of hazmat has the potential to result in lethal and sublethal impacts on birds, including decreased hematological function, dehydration, drowning, hypothermia, starvation, and weight loss (Briggs et al. 1997; Haney et al. 2017; Paruk et al. 2016). Additionally, even small exposures that result in oiling of feather can lead to sublethal effects that include changes in flight efficiencies and result in increased energy expenditure during daily and seasonal activities, including chick provisioning, commuting, courtship, foraging, long-distance migration, predator evasion, and territory defense (Maggini et al. 2017). Based on the volumes potentially involved, the likely amount of additional releases associated with future 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. BOEM assumes all vessels will comply with laws and regulations to minimize releases. In the unlikely event of a release, it would be an accidental, localized event in the vicinity of project areas. Accidentally released trash may be ingested by birds that mistake it for prey. Lethal and sublethal impacts on individuals could occur as a result of blockages caused by both hard and soft plastic debris (Roman et al. 2019), though BOEM expects accidental trash releases from project vessels to be rare events.

Given that the overall impact of accidental releases on birds is anticipated to be localized and short-term, BOEM expects that accidental releases would not appreciably contribute to overall impacts on birds.

Light: Offshore wind development would result in additional light from vessels and from offshore structures at night. Ocean vessels have an array of lights including navigational lights and deck lights. Such lights can attract some birds, primarily during nighttime construction activities, but also during operations and decommissioning. Attraction to project vessels by birds would not be expected to result in increased risk of collision with vessels. Vessels would follow BOEM guidelines for lighting. The resulting vessel-related lighting impacts would be localized and temporary. In a maximum-case scenario, lights could be on 24 hours per day during construction. This could attract birds, and/or potential prey species, to construction zones, potentially exposing them to greater harm from other IPFs associated with construction.

Using the assumptions in Table A-4, up to 2,021 WTGs and 45 ESPs that could be constructed would have navigational and Federal Aviation Administration (FAA) hazard lighting in accordance with BOEM's lighting and marking guidelines, and would be placed on the OCS where few lighted structures currently exist. This lighting has some potential to result in long-term impacts and may pose an increased collision risk to migrating birds (Hűppop et al. 2006), though this risk would be minimized through the use of red flashing FAA lighting (BOEM 2019b; Kerlinger et al. 2010). While small due to the use of red flashing FAA lighting, some potential exists for WTG lighting to result in new collision risk, particularly to night flying migrants during low-visibility weather conditions, on the OCS where few lighted structures currently exist.

New cable emplacement and maintenance activities: Generally, emplacement of submarine cables would result in increased suspended sediments that may impact birds and result in displacement of foraging individuals or decreased foraging success and have impacts on some prey species (Cook and Burton 2010). Using the assumptions in Table A-4, the total area of direct seafloor disturbed by offshore export and inter-array cables for offshore wind facilities is estimated to be up to 8,153 acres (33 km^2). In addition to cables related to individual offshore wind facilities, two unsolicited proposals for the development of two open access offshore transmission systems have been announced. The routes for these proposed regional cables have not been determined at this time and are not considered reasonably foreseeable, but BOEM assumes that if future offshore wind projects utilize one of these open access transmission systems, the impacts associated with new cable emplacement and maintenance activities would be less than if each individual project installed its own cable. In any case, all impacts associated with cable emplacement would be localized and turbidity would be present during installation for 1 to 6 hours at a time. Any dredging necessary prior to cable installation could also contribute to additional impacts. New offshore submarine cables associated with the expanded cumulative scenario would cause short-term disturbance of seafloor habitats and injury and mortality of bird prey species in the immediate vicinity of the cable emplacement activities. Disturbed seafloor from construction of future offshore wind projects may affect some bird prey species; however, assuming future projects use installation procedures similar to those proposed in the Vineyard Wind COP, the duration and extent of impacts would be limited and short-term, and benthic assemblages would recover from disturbance. SEIS Sections 3.3 and 3.4 provide more information. Given that impacts would be temporary, and generally localized to the emplacement corridor, no individual fitness or population-level effects on birds would be expected. Based on the current anticipated construction schedule provided in Table A-6, construction impacts associated with multiple projects could overlap in time and space and could potentially result in greater impacts, though no individual fitness or population-level impacts would be expected to occur because birds would be expected to be able to successfully forage in adjacent areas not affected by increased suspended sediments. Migrating birds that are not actively foraging would not be affected.

Noise: Anthropogenic noise on the OCS associated with future offshore wind development, including noise from aircraft, pile-driving activities, geological and geophysical (G&G) surveys, offshore construction, and vessel traffic has the potential to result in impacts on birds on the OCS. Additionally, onshore construction noise has the potential to result in impacts on birds. BOEM anticipates that these impacts would be localized and temporary. Potential impacts could be greater if avoidance and displacement of birds occurs during seasonal migration periods.

Aircraft may be used to transport construction and maintenance crews and will continue to be used for ongoing wildlife monitoring surveys, though the anticipated level of use would be low and restrictions on low-flying aircraft may be imposed. If flights are at a sufficiently low altitude, birds may flush, resulting in increased energy expenditure. Disturbance, if any, would be temporary and localized, with impacts dissipating once the aircraft has left the area. No individual or population-level effects would be expected.

In the expanded cumulative scenario, Table A-4, construction of 2,066 offshore structures would create noise and may temporarily impact diving birds. The greatest impact of noise is likely to be caused by pile driving activities during construction. Noise from pile driving would occur during installation of foundations for offshore structures and would be produced during construction for 4 to 6 hours at a time over a 6- to 12-year period. Noise transmitted through water has the potential to result in temporary displacement of diving birds in a limited space around each pile and can cause short-term stress and behavioral changes ranging from mild annoyance to escape behavior (BOEM 2014, 2016a). Additionally, effects on foraging success may result from impacts on prey species (Table A-11). The extent of impacts would depend on pile size, hammer energy, and local acoustic conditions. Similar to pile-driving, G&G site characterization surveys for offshore wind facilities would create high-intensity impulsive noise around sites of investigation, leading to similar impacts. The extent depends on equipment used, noise levels, and local acoustic conditions. G&G noise would occur intermittently over an assumed 2- to 10-year period.

Onshore noise associated with intermittent construction of required offshore wind development infrastructure may also result in localized and temporary impacts, including avoidance and displacement, though no individual fitness or population-level effects would be expected to occur.

Noise associated with project vessels could disturb some individual diving birds, but they would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (BOEM 2012). However, brief, temporary responses, if any, would be expected to dissipate once the vessel has passed or the individual has moved away. No individual fitness or population-level effects would be expected.

Presence of structures: The presence of structures can lead to impacts, both beneficial and adverse, on birds through fish aggregation and associated increase in foraging opportunities, as well as entanglement and gear loss/damage, migration disturbances and WTG strikes and displacement. These impacts may arise from buoys, meteorological (met) towers, foundations, scour/cable protections, and transmission cable infrastructure. Using the assumptions in Table A-4, the expanded cumulative scenario would include up to 2,066 foundations, 2,945 acres (12 km^2) of new scour protection for foundations and hard protection atop cables where few currently exist. In addition, the Southern New England OceanGrid Project allows for an up to 16-GW offshore electrical power transmission system; however, this project is not reasonably foreseeable. Projects may also install more buoys and meteorological (met) towers. BOEM anticipates that structures would be added intermittently over an assumed 6- to 10-year period and that they would remain until decommissioning of each facility is complete, approximately 30 years following construction.

In the Northeast and mid-Atlantic waters, there are 2,570 seabird interactions each year with commercial fishing gear; of those, 84 percent are with gillnets involving shearwaters/fulmars and loons (Hatch 2017). Abandoned or lost fishing nets from commercial fishing may get tangled with foundations, reducing the chance that abandoned gear will cause additional harm to birds and other wildlife if left to drift until sinking or washing ashore. A reduction in derelict fishing gear (in this case by entanglement with foundations) has a beneficial impact on bird populations (Regular et al. 2013). In contrast, the presence of structures may also increase recreational fishing and thus expose individual birds to harm from fishing line and hooks; this intermittent impact would persist for the anticipated 30-year life of the proposed Project until decommissioning is complete.

The presence of new structures could result in increased prey items for some marine bird species. WTG and ESP foundations could increase the mixing of surface waters and deepen the thermocline, possibly increasing pelagic productivity in local areas (English et al. 2017). Additionally, the new structure may also create habitat for structure-oriented and/or hard-bottom species. This reef effect has been observed around WTGs, leading to local increases in biomass and diversity (Causon and Gill 2018). Invertebrate and fish assemblages may develop around these reef-like elements within the first year or two after construction (English et al. 2017). Although some studies have noted increased biomass and increased production of particulate organic matter by epifauna growing on submerged foundations, it is not clear to what extent the reef effect results in increased productivity versus simply attracting and aggregating fish from the surrounding areas (Causon and Gill 2018). Recent studies have found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, marine mammals, and birds as well (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019), indicating that offshore wind farms can generate beneficial permanent impacts on local ecosystems, translating to increased foraging opportunities for individuals of some marine bird species. BOEM anticipates that the presence of structures may result in permanent beneficial impacts. Conversely, increased foraging opportunities could attract marine birds, potentially exposing those individuals to increased collision risk associated with operating WTGs.

Offshore wind development would add up to 2,021 WTGs (Table A-4). For this analysis, based on the assumption that structures would be spaced 1 nautical mile apart, ample space between WTGs would allow birds that are not flying above WTGs to fly through individual lease areas without changing course or to make minor course corrections to avoid operating WTGs. Course corrections made to avoid a wind farm could result in exposure to one or more additional wind farms within the geographic analysis area, but again, the one-nautical mile spacing would allow for migrating individuals to make only small course correction, if any, to avoid operating WTGs. Course corrections made by migratory birds to avoid a project or individual WTG would be relatively minor when compared to the distances traveled during seasonal long-distance migrations. Adverse impacts of additional energy expenditure due to minor course corrections or complete avoidance of WDAs would not be expected to be biologically significant. Any additional flight distances would be miniscule when compared with the overall migratory distances traveled by migratory birds, and no individual fitness or population-level effects would be expected to occur. The greatest risk to birds associated with future offshore wind development is expected to be fatal interactions with operating WTGs.

In the contiguous United States, bird collisions with operating WTGs are a relatively rare event, with an estimated 234,000 birds killed annually by 44,577 onshore turbines (Loss et al. 2013). Based on the mortality rate of 6.9 birds per turbine in the Eastern United States (Loss et al. 2013), an estimated 13,945 birds could be killed annually under the build out described under the cumulative impact scenario. However, the actual mortality rate would be expected to be much lower for several reasons. First, 75 percent of the documented onshore mortality is composed of groups (small passerines, diurnal raptors, doves, pigeons, and upland game birds) that would not be expected to encounter operating WTGs associated with offshore wind development in large numbers. Second, factors such as landscape features and weather patterns that influence collision risk are different on the OCS compared to onshore wind facilities. Another approach to estimate collision fatalities is to use a collision risk model (e.g., the Band model [2012] or the Avian Stochastic Collision Risk Model [v2.3.2]). Collision modeling is commonly used at the project level to predict mortality rates for marine bird species in Europe and in the United States (e.g., BOEM 2015b, 2019c). Model inputs (e.g., monthly bird densities, flight behavior, avoidance behavior, turbine specifications) are used to determine the estimated number of annual collisions with operating WTGs. Due to inherent data limitations, these models often represent only a subset of species potentially present. For the 2,021 WTGs anticipated under the cumulative impact scenario, the collision models predicted that 75 marine birds across 12 species would be killed each year (Table A-9). The modeling result is for a subset of marine bird species that had sufficient data to run the models, but does not account for all of the species that may encounter operating WTGs associated with the future offshore wind development on the Atlantic OCS. Nevertheless, due to the relatively little overlap of the 47 marine bird species with future offshore wind energy development (Table A-10), the annual mortality is expected to be low.

Table A-9: Predicted Annual Number of Collision Fatalities by Marine Bird Species on the Atlantic OCS [a]

Species	Median	95% CI
Atlantic puffin (*Fratercula arctica*) [b]	0	NA
Black-legged kittiwake (*Rissa tridactyla*)	0	0–19
Common eider (*Somateria mollissima*)	56	0–465
Common tern (*Sterna hirundo*)	11	3–29
Great black-backed gull (*Larus marinus*)	2	0–1,006
Herring gull (*Larus argentatus*)	0	0–349
Lesser black-backed gull (*Larus fuscus*) [c]	0	NA
Manx shearwater (*Puffinus puffinus*) [b]	0	NA
Northern fulmar (*Fulmarus glacialis*)	0	0–3
Northern gannet (*Morus bassanus*)	0	0–247
Razorbill (*Alca torda*)	0	0–17
Red throated loon (*Gavia stellate*)	6	0–1,346

95% CI = confidence interval; NA = not applicable
[a] Calculated from Avian Stochastic CRM (v2.3.2), using 12-megawatt turbines with 40-meter airgap. Output is from Extended Model (Option 3). Monthly mean densities of flying birds were calculated across regional survey efforts.
[b] Flies below Rotor-Swept Zone, and therefore not at risk of collision with rotating turbine blades.
[c] Unable to use the stochastic model, so the traditional Band model was used.

Table A-10: Percentage of Each Atlantic Seabird Population that Overlaps with Future Offshore Wind Energy Development on the OCS by Season

Species	Spring	Summer	Fall	Winter
Artic tern (*Sterna paradisaea*)	NA	0.2	NA	NA
Atlantic puffin (*Fratercula arctica*) [a]	0.2	0.1	0.1	0.2
Audubon Shearwater (*Puffinus lherminieri)*	0.0	0.0	0.0	0.0
Black-capped petrel (*Pterodroma hasitata)*	0.0	0.0	0.0	0.0
Black Guillemot (*Cepphus grille)*	NA	0.3	NA	NA
Black-legged Kittiwake (*Rissa tridactyla*) [a]	0.7	NA	0.7	0.5
Black Scoter (*Melanitta americana)*	0.2	NA	0.4	0.5
Bonaparte's Gull (*Chroicocephalus philadelphia*)	0.5	NA	0.4	0.3
Brown Pelican (*Pelecanus occidentalis*)	0.1	0.0	0.0	0.0
Band-rumped Storm-Petrel (*Oceanodroma castro*)	NA	0.0	NA	NA
Bridled Tern (*Onychoprion anaethetus*)	NA	0.1	0.1	NA
Common Eider (*Somateria mollissima*) [a]	0.3	0.1	0.5	0.6
Common Loon (*Gavia immer*)	3.9	1.0	1.3	2.1
Common Murre (*Uria aalge*)	0.4	NA	NA	1.9
Common Tern (*Sterna hirundo*) [a]	2.1	3.0	0.5	NA
Cory's Shearwater (*Calonectris borealis*)	0.1	0.9	0.3	NA
Double Crested Cormorants (*Halacrocorax auritus*)	0.7	0.6	0.5	0.4
Dovekie (*Alle alle*)	0.1	0.1	0.3	0.2
Great Black-backed Gull (*Larus marinus*) [a]	1.3	0.5	0.7	0.6
Great Shearwater (*Puffinus gravis*)	0.1	0.3	0.3	0.1
Great Skua (*Stercorarius skua*)	NA	NA	0.1	NA
Herring Gull (*Larus argentatus*) [a]	1.0	1.3	0.9	0.5
Horned Grebe (*Podiceps auritus*)	NA	NA	NA	0.3
Laughing Gull (*Leucophaeus atricilla*)	1.0	3.6	0.9	0.1
Leach's Storm-Petrel (*Oceanodroma leucorhoa*)	0.1	0.0	0.0	NA
Least Tern (*Sternula antillarum*)	NA	0.3	0.0	NA
Long-tailed Ducks (*Clangula hyemalis*)	0.6	0.0	0.4	0.5
Manx Shearwater (*Puffinus puffinus*) [a]	0.0	0.5	0.1	NA
Northern Fulmar (*Fulmarus glacialis*) [a]	0.1	0.2	0.1	0.2
Northern Gannet (*Morus bassanus*) [a]	1.5	0.4	1.4	1.4
Parasitic Jaeger (*Stercorarius parasiticus*)	0.4	0.5	0.4	NA
Pomarine Jaeger (*Stercorarius pomarinus*)	0.1	0.3	0.2	NA
Razorbill (*Alca torda*) [a]	5.2	0.2	0.4	2.1
Ring-billed Gull (*Larus delawarensis*)	0.5	0.5	0.9	0.5
Red-breasted Merganser (*Mergus serrator*)	0.5	NA	NA	0.7
Red Phalarope (*Phalaropus fulicarius*)	0.4	0.4	0.2	NA
Red-necked Phalarope (*Phalaropus lobatus*)	0.3	0.3	0.2	NA
Roseate Tern (*Sterna dougallii*)	0.6	0.0	0.5	NA
Royal Tern (*Thalasseus maximus*)	0.0	0.2	0.1	NA
Red-throated Loon (*Gavia stellate*) [a]	1.6	NA	0.5	1.0
Sooty Shearwater (*Ardenna grisea*)	0.3	0.4	0.2	NA
Sooty Tern (*Onychoprion fuscatus*)	0.0	0.0	NA	NA
South Polar Skua (*Stercorarius maccormicki*)	NA	0.2	0.1	NA

Species	Spring	Summer	Fall	Winter
Surf Scoter (*Melanitta perspicillata*)	1.2	NA	0.4	0.5
Thick-billed Murre (*Uria lomvia*)	0.1	NA	NA	0.1
Wilson's Storm-Petrel (*Oceanites oceanicus*)	0.2	0.9	0.2	NA
White-winged Scoter (*Melanitta deglandi*)	0.7	NA	0.2	1.3

Source: Calculated from Winship et al. 2018; Appendix D

NA = not applicable
[a] species used in collision risk modeling

As described in the Draft EIS, not all individuals that occur, or migrate, along the Atlantic coast are expected to encounter the rotor swept area of one or more operating WTGs associated with future offshore wind development. Generally, only a small percentage of a species' seasonal population would potentially encounter operating WTGs (Table A-10). The addition of WTGs to the offshore environment may result in increased functional loss of habitat for those species with higher displacement sensitivity. However, as described in the Draft EIS, substantial foraging habitat for resident birds would remain available outside of the proposed offshore lease areas, and no individual fitness or population-level impacts would be expected to occur.

Aircraft traffic: General aviation traffic accounts for approximately two bird strikes per 100,000 flights (Dolbeer et al. 2019). Because aircraft flights associated with offshore wind development are expected to be minimal in comparison to baseline conditions, aircraft strikes with birds are highly unlikely to occur. As such, aircraft traffic would not be expected to appreciably contribute to overall impacts on birds.

Onshore construction: Construction activities associated with onshore construction of required offshore wind development infrastructure has the potential to result in some indirect impacts due to habitat loss and/or fragmentation. However, onshore construction would be expected to account for only a very small increase in development relative to other ongoing development activities. Further, construction would be expected to generally occur in previously disturbed habitats and no individual fitness or population-level impacts on birds would be expected to occur. As such, onshore construction associated with future offshore wind development would not be expected to appreciably contribute to overall impacts on birds.

Climate change: Several sub-IPFs related to climate change, including increased storm severity and frequency, ocean acidification, altered migration patterns, increased disease frequency, protective measures, and increased erosion and sediment deposition have the potential to result in long-term, potentially high-consequence risks to birds and could lead to changes in prey abundance and distribution, changes in nesting and foraging habitat abundance and distribution, and changes to migration patterns and timing. Section A.8.1 provides more details on the expected contribution of offshore wind to climate change.

A.8.3.1.2 Conclusions

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impacts on birds. BOEM expects ongoing activities and future offshore wind activities to have continuing temporary to permanent impacts on birds primarily through accidental releases, anthropogenic noise, presence of structures, and climate change. Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in **moderate** adverse impacts but could potentially include moderate beneficial impacts because of presence of structures. The majority of offshore structures in the geographic analysis area would be attributable to the offshore wind development. Migratory birds that use the offshore WDAs during all or parts of the year will either be exposed to new collision risk, or will have long-term functional habitat loss due to behavioral avoidance and displacement from WDAs on the OCS. The offshore wind development would also be responsible for the majority of impacts related to new cable emplacement and pile-driving noise, but effects on birds resulting from these IPFs would be localized and temporary and would not be expected to be biologically significant.

Under the No Action Alternative, the resource would continue to follow the current general decreasing trends, as described in Section A.8.3.1, and respond to current and future environmental and societal activities. The No Action Alternative would forego the post-construction avian monitoring for Endangered Species Act–listed species and annual mortality reporting that Vineyard Wind has committed to performing, the results of which could provide an understanding of the effects of offshore wind development, benefit the future management of these species, and inform planning of other offshore development.

A.8.3.2. Proposed Action and Action Alternatives

A.8.3.2.1 Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on birds are described in Draft EIS Section 3.3.2.3 and additional information is provided in Table A-11. The Proposed Action would likely result in both long-term and localized, temporary **negligible** to **minor** impacts on birds, and may include **minor beneficial** impacts. The Proposed Action would contribute to impacts on all IPFs addressed in Section A.8.3.1.1.

A total of five IPFs or sub-IPFs discussed in Table A-11, including new cable emplacement, aircraft traffic, G&G survey noise, beneficial impacts resulting from the presence of structures, and climate change impacts, were not discussed previously in the Draft EIS sections on birds.

The Draft EIS and the Biological Assessment submitted to the USFWS (BOEM 2019c) addressed impacts of sedimentation resulting from cable laying activities within Lewis Bay on roseate terns. However, subsequent to publication of the Draft EIS, this IPF has been expanded to include a discussion of impacts associated with all cable laying activities, including the offshore export cable as well as inter-array cables. Some localized and temporary negligible impacts on individuals foraging in the vicinity of the proposed Project construction activities may occur. However, given the localized nature of the potential impacts, individuals would be expected to successfully forage in nearby areas not affected by the proposed Project construction and no individual fitness or population-level effects would be expected.

The Draft EIS did not contemplate the impacts of aircraft on birds. Aircraft may be used to transport construction and operations and maintenance crews, and would continue to be used for ongoing academic and resource agency wildlife monitoring and surveys. The level of use would be low. If flights are at a sufficiently low altitude, noise from passing aircraft may cause birds to flush, resulting in increased energy expenditure. Only two avian collisions occur per 100,000 flights. Given the low number of transport, monitoring, and survey flights, collisions would be unlikely to occur. Disturbance, if any, would be localized and temporary, with impacts dissipating once the aircraft has left the area. These negligible impacts, if any, would not be expected to result in individual fitness or population-level effects.

The Draft EIS also did not consider noise from G&G surveys. It was previously assumed that the Proposed Action would not lead to impacts related to site-assessment G&G surveys as these surveys had already been completed for the Proposed Action. However, Table A-11 now considers the potential impacts of G&G surveys associated with operations, maintenance, and decommissioning activities. G&G surveys associated with the inspection of proposed Project cables and foundations after installation and with site clearance activities associated with decommissioning may result in impacts on birds. G&G survey effort resulting from these post-construction surveys may be shorter in duration and smaller in scope than site investigation surveys in WDAs. Negligible impacts on diving birds, if any, are anticipated to be localized, temporary, and expected to result in temporary displacement. Impacts could be greater if G&G surveys occurred in preferred foraging locations during seasonal migration periods but would still be expected to be negligible.

The Draft EIS also did not consider how the presence of structures could result in both beneficial and adverse impacts as a result of the reef effect from foundation protection measures. As described in Section A.8.3.1.1, offshore structures can increase biodiversity, thus providing long-term minor beneficial impacts to foraging marine birds. Conversely, this beneficial impact can give rise to the potential for long-term minor impacts on foraging individuals by potentially increasing the interaction with operating WTG blades and abandoned/lost recreational fishing gear that could result in individual injury and/or mortality due to ingestion and/or entanglement.

Finally, while the Draft EIS states that some bird species may be susceptible to impacts arising from climate change, no discussion of what those impacts might be was provided. Several sub-IPFs discussed in A-9, including increased storm severity and frequency, ocean acidification, altered migration patterns, increased disease frequency, protective measures, and increased erosion and sediment deposition, have the potential to result in long-term, possibly high-consequence risks to birds and could lead to reduced productivity, mortality of chicks and adults, changes in prey abundance, availability, and distribution, changes in nesting and foraging habitat abundance, availability, and distribution, and changes to migration patterns and timing.

Changes to the design capacity of the WTGs proposed in the Vineyard Wind COP (Epsilon 2020) would not alter the maximum potential bird impacts for the Proposed Action and all other action alternatives because the maximum-case scenario involved the maximum number of WTGs (100) allowed in the PDE. Changes to the proposed onshore substation site could modify the impacts of the Proposed Action and all other action alternatives on birds. Since the Draft EIS was published, the substation area has been expanded, and the total approximate area of ground disturbance would be 7.7 acres (31,161 m^2), or 1.8 acres (7,122 m^2) greater than the 5.9 acres (23,877 m^2) assumed in the Draft EIS. The majority of ground disturbance would occur in previously disturbed (paved) areas where no tree clearing would be needed (potentially 0.2 acre [809 m^2] may require tree clearing). The southern portion of the expanded substation area is wooded, and an additional 0.2 acre [809 m^2] may need to be cleared, for a total of 6.1 acres (24,686 m^2) of tree clearing. This 6.1 acres (24,686 m^2) of tree clearing is within the estimated 7 acres (28,328 m^2) of tree clearing analyzed in the Draft EIS. Considering these changes, the direct and indirect impacts of the Proposed Action and all other action alternatives on birds through land disturbance are still expected to be negligible.

The cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities would be of the similar types described in Section A.8.3.1 but may differ in intensity and extent. It is assumed that the energy demand that the Vineyard Wind 1 Project would fill (if approved) would likely be met by other projects in remaining areas of the Massachusetts, Rhode Island, and/or New York leases (if not approved). Although the impacts from a substitute project may differ in location and time, depending on where and when offshore wind facilities are developed to meet the remaining demand, the nature of impacts and the total number of WTGs would be similar either with or without the Proposed Action, as described in Section A.8.3.1. In other words, future offshore wind facilities capable of generating 9,404 MW would be built in the RI and MA Lease Areas, although, in the absence of the Proposed Action, none would be built before 2021.

Accidental releases: As described in Table A-11, some potential for mortality, decreased fitness, and health effects exists due to the accidental release of fuel, hazmat, and trash and debris from vessels associated with the Proposed Action. All vessels associated with the Proposed Action would comply with the USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize effects on offshore bird species resulting from the release of debris, fuel, hazmat, or waste (BOEM 2012). Additionally, training and awareness of BMPs proposed for waste management and mitigation of marine debris would be required of Vineyard Wind 1 Project personnel, reducing the likelihood of occurrence to a very low risk. These releases, if any, would occur infrequently at discrete locations and vary widely in space and time and as such, BOEM expects localized and temporary **negligible** impacts on birds. Future offshore wind activities would contribute to an increased risk of spills and associated impacts due to fuel, fluid, or hazmat exposure. The contribution from future offshore wind and the Proposed Action would be a low percentage of the overall spill risk from ongoing activities. The cumulative impacts on birds from accidental releases associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be localized and temporary due to the likely limited extent and duration of a release resulting in **negligible** impacts.

Light: The Proposed Action's incremental contribution of up to 100 WTGs and two ESPs, all of which would be lit with navigational and FAA hazard lighting. Per BOEM guidance (2019b) and outlined in the Vineyard Wind COP (Volume I, Section 3.1.1; Epsilon 2020) each WTG would be lit with two FAA "L-864" aviation red flashing obstruction lights on top of the nacelle, adding up to 200 new red flashing lights to the offshore environment where none currently exist; these lights have some potential to attract birds and result in increased collision risk (Hűppop et al. 2006). Additionally, marine navigation lighting would consist of multiple flashing yellow lights on each WTG and on the corners of each ESP. The proposed Vineyard 1 Project is proposing to use an Aircraft Detection Light System, which if implemented would only activate WTG lighting when aircraft enter a predefined airspace. For the Proposed Action, this was estimated to occur 235 times during the year, with illuminating less than 0.1 percent of nighttime hours per year (Draft EIS Section 3.4.4.4 and SEIS Section 3.10). As such, BOEM expects impacts, if any, to be long-term, but **negligible** from lighting. Should the Proposed Action involve the use of taller 14-MW WTGs, additional mid-mast lighting would be required, resulting in three lights additional red flashing FAA aviation obstruction lights per WTG for a total of 285 (57 x 5 = 285) red flashing lights on the OCS where none currently exist. Vessel lights during construction, operations, and decommissioning would be minimal and likely limited to vessels transiting to and from construction areas. Cumulative impacts, if any, would be **negligible** from lighting, and no individual or population-level impacts would be expected. Under the cumulative impact scenario, up to 2,021 turbines and 45 ESPs would have lights, and these would be incrementally added over time beginning in 2021 and continuing through 2030. Lighting of turbines and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM (2019b) guidance. The cumulative impacts on birds from lighting associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be expected to have **negligible**, non-measurable cumulative impacts on birds. Ongoing and future non-offshore wind activities are expected to cause permanent impacts, primarily driven by light from onshore structures and short-term and localized impacts from vessel lights.

New cable emplacement and maintenance: The Proposed Action's incremental contribution of up to 328 acres (1.3 km^2) of seafloor disturbed by cable installation and up to 69 acres (0.3 km^2) affected by dredging prior to cable installation would result in turbidity effects that have the potential to reduce marine bird foraging success or have temporary and localized impacts on marine bird prey species. These impacts are expected to be temporary, lasting up to 12 hours, localized to the emplacement corridor, extending up on 1.2 miles (2 kilometers; Section A.8.2 has further details). However, individual birds would be expected to successfully forage in nearby areas not affected by increased sedimentation during cable emplacement and only non-measurable **negligible** impacts, if any, on individuals or populations would be expected given the localized and temporary nature of the potential impacts. Based on the assumptions in Table A-4, only the South Fork Wind Project would overlap in time with the Proposed Action for a limited time in 2021. However, given the localized nature of these impacts, impacts associated with the emplacement of South Fork Wind's export and inter-array cabling would not overlap spatially with the Proposed Action and **negligible**, if any, cumulative impacts would be expected. 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 also generate additional impacts. The cumulative impacts on birds from new cable emplacement associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would include up to 8,153 acres (33 km^2) of seafloor disturbed from the offshore export cable and inter-array cables. No measurable impacts on birds would be attributed to new cable emplacement from the Proposed Action; however, some level of cumulative impacts arising from future activities could occur if impacts are in close temporal and spatial proximity. However, these cumulative impacts from cable emplacement would be expected to be **negligible**, and would not be expected to be biologically significant.

Noise: The expected **negligible** incremental impacts of aircraft, G&G survey, and pile driving noise associated with the Proposed Action would not increase the impacts of noise beyond the impacts described under the No Action Alternative. Therefore, cumulative impacts on birds from noise associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be expected to be similar to the impacts under the No Action Alternative and would be expected to be **negligible**.

Presence of structures: The various types of impacts on birds that could result from the presence of structures, such as fish aggregation and associated increase in foraging opportunities, as well as entanglement and fishing gear loss/damage, migration disturbances, and WTG strikes and displacement, are described in detail in Section A.8.3.1.1. The Proposed Action's incremental impacts as a result of presence of structures would be **minor** impacts, and may include **minor beneficial** impacts. Using the assumptions in Table A-4, there could be up to approximately 2,021 WTGs within the geographic analysis area. Of these, a maximum of 100 WTGs would result from the proposed Project, and the remainder is the estimated result of other offshore wind projects in the geographic analysis area. The structures associated with the Proposed Action and the consequential impacts, would remain at least until decommissioning of the proposed Project is complete. The cumulative impacts on birds from the presence of structures associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be expected to range from **negligible to moderate** based on the sub-IPFs identified in Table A-11 and may result in **moderate beneficial** impacts, due to the large number of structures. A majority (approximately 95 percent) of these impacts would occur as a result of structures associated with other future offshore wind development and not the Proposed Action, as the Proposed Action would account for 4.9 percent (100 of 2,021) of the new WTGs on the OCS.

Aircraft Traffic: The expected **negligible** incremental impacts of aircraft traffic associated with the Proposed Action would not increase the impacts of this IPF beyond the impacts described under the No Action Alternative. Therefore, cumulative impacts on birds from aircraft traffic associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be expected to be similar to the impacts under the No Action Alternative and would be expected to be **negligible**.

Onshore Construction: The expected **negligible** incremental impacts of onshore construction associated with the Proposed Action would not increase the impacts of this IPF beyond the impacts described under the No Action Alternative. Therefore, cumulative impacts from onshore construction would be expected to be similar to the impacts under the No Action Alternative and would be expected to be remain **negligible** and would not be expected to noticeable change to the condition of birds in the geographic analysis area.

Other considerations: For temporary impacts, including the effects of accidental releases, anthropogenic noise, new cable emplacement, and onshore construction, it is likely that a portion, possibly a majority, of such impacts from future activities would not overlap temporally or spatially with the Proposed Action. However, some IPFs that may result in temporary impacts can also result in long-term to permanent impacts.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from **negligible** to **moderate**, but could potentially include **moderate beneficial** impacts. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in **moderate** impacts to birds in the geographic analysis area. The main drivers for this impact rating are ongoing climate change and the potential for direct mortality resulting from fatal interactions with operating WTGs associated with the cumulative impact scenario. The Proposed Action would contribute to the overall impact rating primarily through the permanent impacts due to the presence of structures. Therefore, the overall cumulative impacts on birds would likely qualify as **moderate** because a notable and measurable impact is anticipated, but the resource would likely recover completely when the WTGs are removed and/or remedial or mitigating actions are taken.

A.8.3.2.2 Cumulative Impacts of Alternatives B, C, D1 and D2

As discussed in Draft EIS Section 3.3.2.4, , the direct and indirect impacts resulting from individual IPFs associated with Alternative B, C, D1, and D2 would be similar to those described under the Proposed Action. The only difference between Alternative B and the Proposed Action is the selection of Covell's Beach as the landfall site; therefore, impacts on the Lewis Bay foraging habitat would be avoided. The only difference between Alternative C and the Proposed Action is shifting WTG locations south, but with no change in the proposed Project footprint, this would not alter the potential for collision risk or habitat loss due to behavioral avoidance. Under Alternatives D1 and D2, the acreage of the WDA would increase compared to the Proposed Action, potentially leading to a slightly increased risk of migrating birds encountering the WDA, though the additional spacing between WTGs would allow for individuals to make only minor, if any, course corrections to avoid operating WTGs. Some additional loss of suitable habitat for bird species with high displacement sensitivity would occur under Alternatives D1 and D2. While each of the alternatives, as described in this SEIS Section 2.1, would slightly change the potential impacts, the incremental impacts would not be expected to be materially different that those described under the Proposed Action; they would include **negligible** to **minor** impacts and possibly **minor beneficial** impacts.

While Alternatives D1 and D2 may be slightly more impactful to birds than the Proposed Action, the cumulative impacts of Alternatives B, C, D1, and D2 would be similar to cumulative impacts under the Proposed Action (with individual IPFs leading to impacts ranging from **negligible** to **moderate** and potentially **moderate beneficial** impacts). The overall cumulative impacts of Alternatives B, C, D1, and D2 when combined with past, present, and reasonably foreseeable activities on birds within the geographic analysis area would be the same level as under the Proposed Action—**moderate**. This impact rating is driven primarily by ongoing activities such as climate change as well as the presence of operating WTGs on the OCS.

A.8.3.2.3 Cumulative Impacts of Alternative E

As discussed in Draft EIS Section 3.3.2.5 the direct and indirect impacts under Alternative E would be slightly less than those described under the Proposed Action. IPFs associated with the construction and installation of no more than 84 WTGs, including accidental releases, pile-driving noise, temporary avoidance and displacement, turbidity, and sediment deposition, would be reduced by approximately 16 percent compared to the maximum-case scenario under the Proposed Action, namely 100 WTGs. As demonstrated by Johnston et al. (2014), the use of fewer and taller WTGs may be an effective method of reducing bird collision risk. In addition to reduced collision risk, functional habitat loss to those species with higher displacement sensitivity would be slightly smaller due to the reduced Project footprint. Should the Proposed Action involve the use of taller 14-MW WTGs, an even greater reduction in potential collision risk and functional habitat loss would result. However, the overall expected **negligible** to **minor** impacts and potential **minor beneficial** impacts on birds would not be expected to be materially different than those described under the Proposed Action.

While Alternative E may be slightly less impactful to birds than the Proposed Action, the cumulative impacts of Alternative E would be similar to cumulative impacts under the Proposed Action (with individual IPFs leading to impacts ranging from **negligible** to **moderate** and potentially **moderate beneficial** impacts). The overall cumulative impacts of Alternative E when combined with past, present, and reasonably foreseeable activities on birds within the geographic analysis area, would be the same level as under the Proposed Action–**moderate**. This impact rating is driven primarily by ongoing activities such as climate change as well as the presence of operating WTGs on the OCS.

A.8.3.2.4 Direct, Indirect, and Cumulative Impacts of Alternative F

Alternative F analyzes a vessel transit lane through the WDA in which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500.The WTGs that would have been located within the transit lane would not be eliminated from the Proposed Action; instead, the displaced WTGs would be shifted to locations south within the lease area. Under this alternative, BOEM is analyzing a 2- and 4-nautical-mile northwest/southeast vessel transit lane through the WDA combined with any action alternative; however, this analysis focuses on the combination of Alternative F with either the Proposed Action or the Alternative D2 layout. Therefore, the number of turbines would remain the same. Under Alternative F, the total project footprint acreage of the WDA would increase, which could potentially lead to a slightly increased risk of migrating birds encountering the WDA; however, collision risk would not be expected to change as the number of WTGs would remain the same. Some additional loss of suitable habitat for bird species with high displacement sensitivity would occur under the combination of Alternative F with any of the action alternatives, but particularly with Alternatives D1 or D2. No additional loss of suitable habitat for bird species with high displacement sensitivity would occur under Alternative F (Draft EIS Figure 3.3.2-2). Alternative F would not change the potential direct and indirect impacts, and the expected **negligible** to **minor** impacts and potential **minor beneficial** impacts would not be expected to be materially different than those described under the Proposed Action because the southern portion of the WDA would not include areas with higher densities of resident or migrating birds and the total number of WTGs would remain the same. The direct and indirect impacts from the combination of the Alternative F with Alternative A or Alternative D2 is expected to be similar to combinations with the other alternatives. Consequently, these other potential combinations are not separately analyzed here.

In considering the cumulative impacts of Alternative F and other ongoing and future activities, BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The cumulative impacts resulting from individual IPFs associated up to a 4-nautical mile transit lane under Alternative F when combined with past, present, and reasonably foreseeable activities on birds are not likely to be materially different from the Proposed Action, and the individual IPFs would range from **negligible** to **moderate** and may include **moderate beneficial** impacts. The overall cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities on birds would be of the same level as under the Proposed Action—**moderate**. This impact rating is driven primarily by ongoing activities such as climate change as well as the presence of operating WTGs on the OCS.

BOEM has qualitatively evaluated the cumulative impacts of implementing all six RODA-recommended transit lanes, including the northern transit lane described for Alternative F, as well as five other transit lanes through the RI and MA Lease Areas. To the extent additional transit lanes are implemented in the future outside the WDA as part of RODA's suggestion, one or more reasonably foreseeable offshore wind projects may not be able to deliver the expected power generation capacity and therefore the demand for power generation capacity could not likely be met. Therefore, the total number of WTGs would be less than that of the cumulative scenario above. As a result, the technical capacity of offshore wind power generation would not be met, and the total number of foundations and WTGs expected in the cumulative scenario would decrease. However, as with the incremental impacts of the proposed Project under Alternative F, the other projects intersected by transit lanes may also require a resulting shift in turbine placement, thus increasing the amount of cable, but collision risk would not be expected to change as the number of WTGs is assumed to remain the same. Some additional loss of suitable habitat for bird species with high displacement sensitivity may occur if in the future all six transit lanes are implemented, but biologically significant impacts would not be expected because there is little overlap with the six transit lanes with birds sensitive to displacement (Draft EIS Figure 3.3.2-2).

A.8.3.2.5 Comparison of Alternatives

As discussed in Draft EIS Section 3.3.2.7, and the above sections, the expected direct and indirect **negligible** to **minor** impacts and potential **minor beneficial** impacts associated with the Proposed Action would not change substantially under Alternatives B through F. While the alternatives have some potential to result in slightly different impacts on birds, the same construction, operations and maintenance, and decommissioning activities would still occur, albeit at differing scales in some cases. Alternatives D1, D2, and F may result in slightly more, but not materially different, **negligible** to **minor** impacts and **minor beneficial** impacts on species with higher collision sensitivity and species with higher displacement sensitivity due to an expanded Project footprint. Alternative E may result in slightly less, but not materially different, **negligible** to **minor** impacts and **minor beneficial** impacts on high-collision sensitive and high-displacement sensitive species due to a reduced number of WTGs and Project footprint. Therefore, the overall direct and indirect **negligible** to **minor** impacts and **minor beneficial** impacts would be very similar across all alternatives. Any action alternative would include monitoring for potential effects on Endangered Species Act–listed species, annual mortality reporting, and the development of a post-construction monitoring program. Information gained via monitoring could be used to inform Vineyard Wind's decommissioning procedures and could also be used to assist other future offshore wind projects in selecting the least impactful method(s).

Cumulative impacts under any action alternative would likely be similar because the majority of the cumulative impacts of any alternative come from other future offshore wind development, which does not materially change between alternatives. However, the differences in incremental impacts between action alternatives would still apply when considered alongside the impacts of other ongoing and future activities. Therefore, cumulative impacts on birds would be slightly higher but not materially different under Alternatives D1, D2, and F, and slightly lower but not materially different under Alternative E. The cumulative impacts resulting from individual IPFs associated with the any alternative would range from **negligible** to **moderate** due to behavioral avoidance, temporary or permanent displacement, injury, and mortality, and may include **moderate beneficial** impacts due to the presence of structures.

In conclusion, the overall cumulative impacts on birds from any alternative, including the No Action Alternative, when combined with past, present, and reasonably foreseeable activities are expected to be **moderate**. The main drivers for this are a result of ongoing activities, the presence of WTGs, and climate change, which are expected to lead to noticeable temporary and permanent impacts across much of the geographic analysis area, of which a small portion is contributed by the Proposed Action. The presence of new structures could benefit some prey species that depend on hard structure and thereby provide increased foraging opportunities for bird species within the geographic analysis area.

Table A-11: Summary of Activities and the Associated Impact-Producing Factors for Birds

Baseline Conditions: More than one-third of bird species that occur in North America (37 percent, 432 species) are at risk of extinction unless significant conservation actions are taken (NABCI 2016). The Northeast United States is also home to more than one-third of the human population of the nation. As a result, species that live or migrate through the Atlantic Flyway have historically been, and will continue to be, subject to a variety of human-caused stressors that have the potential to have impacts on bird species.

Globally, monitored offshore bird populations have declined by nearly 70 percent from 1950 to 2010, which may be representative of the overall population trend of seabirds (Paleczny et al. 2015). Overall, offshore bird populations are decreasing; however, considerable differences in population trajectories of offshore bird families have been documented.

Each year, almost 86,000 sea ducks such as the Long-tailed Duck (27,000), Common Eider (12,500), Black Scoter (19,400), White-winged Scoter (3,300), and Surf Scoter (23,500) are harvested on the Atlantic Flyaway (Roberts 2019). Sea duck mortality due to hunting pressure is expected to continue at the current rate commensurate with the current trend in hunting effort.

In the Northeast and mid-Atlantic waters, there are 2,570 seabird interactions each year with commercial fishing gear; of those, 84 percent are with gillnets involving shearwaters/fulmars and loons (Hatch 2017).

In the United States, domestic cats (free ranging and feral) kill 2.4 billion birds a year (Loss et al. 2015). Avian mortality associated with predation by free-ranging cats is expected to continue at the current rate commensurate with the number of free-ranging cats.

Coastal birds, especially those that nest in coastal marshes and other low-elevation habitats, are additionally vulnerable to sea-level rise and the increasing frequency of strong storms due to global climate change. Models of vulnerability to climate change have estimated that, throughout Massachusetts, 61 species (43 percent of the 143 species modeled) are highly vulnerable, and 22 species (15 percent) are likely vulnerable (Mass Audubon 2017).

The marine bird behavioral response to offshore wind energy development is species-specific (Krijgsveld 2014). Some may be attracted to the structures, while some may entirely avoid the area of development and others may be indifferent or habituate to the presence of new structures. Sea ducks, loons, alcids, and gannets are birds that may avoid areas with structures and consequently could be displaced from foraging areas while others like cormorants and large gulls are attracted to the structures for roosting.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/ hazmat	See Table A-8 for a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Ingestion of hydrocarbons can lead to morbidity and mortality due to decreased hematological function, dehydration, drowning, hypothermia, starvation, and weight loss (Briggs et al. 1997, Haney et al. 2017, Paruk et al. 2016). Additionally, even small exposures that result in feather oiling can lead to sublethal effects that include changes in flight efficiencies and result in increased energy expenditure during daily and seasonal activities including chick provisioning, commuting, courtship, foraging, long-distance migration, predator evasion, and territory defense (Maggini et al. 2017). These impacts rarely result in population-level impacts.	See Table A-8 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 30 years would increase the potential risk of accidental releases and associated impacts, including mortality, decreased fitness, and health effects on individuals. Impacts are unlikely to affect populations.	See Table A-8 for a quantitative analysis of these risks. Based on the volumes potentially involved, the additional impact would fall within the range of ongoing activities, primarily during construction, but also during operations and decommissioning.	See Table A-8 for a quantitative analysis of these risks. The Proposed Action would increase the risk of releases, which would have localized, temporary negligible impacts including individual mortality, decreased fitness, and health effects. Further, all vessels associated with the Proposed Action would comply with the USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize impacts on offshore bird species resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012a).	See Table A-8 for a quantitative analysis of these risks. The Proposed Action could lead to an increased potential for a release that may result in localized and temporary negligible impacts, including individual mortality, decreased individual fitness, and health effects. However, all vessels associated with the Proposed Action will comply with the USCG requirements for the prevention and control of oil and fuel spills, which would minimize impacts on offshore bird species resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012a). The impacts from ongoing activities and future non-offshore wind activities stem from the increased potential for releases over the next 30 years due to increasing vessel traffic and ongoing releases, which are frequent/chronic. Future offshore wind activities would contribute to an increased risk of spills and associated impacts due to fuel, fluid, or hazmat exposure. The contribution from future offshore wind and the Proposed Action would be a low percentage of the overall spill risk from ongoing activities. Cumulatively, the expected negligible impacts on birds associated with the Proposed Action and past, present, and reasonably foreseeable activities are expected to be highly localized and temporary due to the likely limited extent and duration of a release, described in detail in the Draft EIS Section A.8.2.2.3.
Accidental releases: Trash and debris	Trash and debris are accidentally discharged through onshore sources; fisheries use; dredged material ocean disposal; marine minerals extraction; marine transportation, navigation, and traffic; survey activities; and cables, lines, and pipeline laying on an ongoing basis. In a study from 2010, students at sea collected more than 520,000 bits of plastic debris per square mile. In addition, many fragments come from consumer products blown out of landfills or tossed out as litter. (Law et al. 2010). Birds may accidentally ingest trash mistaken for prey. Mortality is typically a result of blockages caused by both hard and soft plastic debris (Roman et al. 2019).	As population and vessel traffic increase gradually over the next 30 years, accidental release of trash and debris may increase. This may result in increased injury or mortality of individuals. However, there does not appear to be evidence that the volumes and extents would have any impact on bird populations.	Trash and debris may be released by vessels during construction, operations, and decommissioning. An accidental release would be a localized event in the vicinity of Project areas, likely resulting in little change to the resource.	Trash and debris may be released by vessels during construction, operations, and decommissioning. BOEM assumes all vessels will comply with laws and regulations to minimize releases. In the event of a release, it would be an accidental, localized event in the vicinity of Project areas, likely resulting in non-measurable negligible impacts, if any. Further, BMPs proposed for waste management and mitigation for marine debris training and awareness of Vineyard Wind 1 Project personnel will be required, reducing the likelihood of occurrence to a very low risk.	The Proposed Action could lead to non-measurable, negligible impacts on birds, including individual injury or mortality caused by ingesting trash and debris. Additionally, training and awareness of BMPs proposed for waste management and mitigation of marine debris would be required of Vineyard Wind 1 Project personnel, reducing the likelihood of occurrence to a very low risk. The impacts from ongoing activities and future non-offshore wind activities would be similar in nature, but of a greater spatial and temporal extent. Future offshore wind activities would likely result in much more accidental trash and debris releases than the Proposed Action, but the overall risk would still be considered low. Cumulatively, the expected negligible impacts on birds through this sub-IPF associated with the Proposed Action and past, present, and reasonably foreseeable activities are expected to be short-term and localized, with the Proposed Action having little-to-no influence on cumulative impacts through this sub-IPF.
Light: Vessels	Ocean vessels have an array of lights including navigational lights, deck lights, and interior lights. Such lights can attract some birds. The impact is localized and temporary. This attraction would not be expected to result in an increased risk of collision with vessels, but may lead to accidental trash ingestion (see Accidental Releases: Trash and debris row). Population-level impacts would not be expected.	Gradually increasing vessel traffic over the next 30 years would increase the potential for bird and vessel interactions. While birds may be attracted to vessel lights, this attraction would not be expected to result in increased risk of collision with vessels, but may lead to accidental trash ingestion (see Accidental Releases: Trash and debris row). No population-level impacts would be expected.	In a maximum-case scenario, lights could be active 24 hours per day during construction. This could attract birds to construction zones, potentially exposing them to greater harm from other IPFs. If there were no nighttime construction, this would not be a factor. Some vessel lighting could also occur during operations and decommissioning.	The Proposed Action would allow nighttime work on an as-needed basis, in which case the Project would reduce lighting of vessels. These impacts would be highly localized and would exist only as long as the lights were in use. Navigation lights during construction, operations, and decommissioning would be minimal, and are expected to cause a negligible impact, if any, on birds, with no individual fitness or population-level impacts expected.	The Proposed Action is expected to cause negligible impacts on birds from this sub-IPF. The impacts of ongoing activities and future non-offshore wind activities (attraction, exposure to other IPFs) are highly localized, temporary to short-term, and greater than the expected impacts of future offshore wind activities. Future offshore wind activities would likely result in the same type of impacts, but with a smaller spatial and temporal extent than ongoing activities. No cumulative impacts of this sub-IPF on birds can be attributed to the Proposed Action, although ongoing and activities, including other offshore wind projects, are expected to result in some highly localized and short-term negligible impacts.
Light: Structures	Offshore buoys and towers emit light, and onshore structures, including houses and ports, emit a great deal more light on an ongoing basis. Buoys, towers,	Light from onshore structures is expected to gradually increase in proportion with human population growth along the coast.	Up to 2,021 turbines and 45 ESPs would have lights, and these would be incrementally added over time. Lighting of turbines and other structures would be	Up to 100 WTGs and two ESPs will have aviation hazard navigation lights for 30 years. Red flashing aviation obstruction lights are commonly used at	The Proposed Action is expected to result in non-measurable negligible impacts, if any, on birds through this sub-IPF. The impacts from ongoing activities and future non-offshore wind activities are widespread and

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	and onshore structures with lights can attract birds. This attraction has the potential to result in an increased risk of collision with lighted structures (Huppop et al. 2006). Light from structures is widespread and permanent near the coast, but minimal offshore.	This increase is expected to be widespread and permanent near the coast, but minimal offshore.	minimal (navigation and aviation hazard lights) in accordance with BOEM guidance (BOEM 2019a). Use of red flashing lights could reduce the potential increase in collision risk (Kerlinger et al. 2010).	land-based wind facilities without any observed increase in avian mortality compared with unlit turbine towers (Kerlinger et al. 2010). Vineyard Wind would use red flashing lights as a measure to decrease the likelihood of attracting migrating birds to the operating WTGs and to minimize the risk of bird collisions. The Vineyard Wind 1 Project is also proposing to use ADLS, which would mean that FAA lighting would be used only 10% of the time at night. The proposed use of ADLS would substantially reduce the amount of light emitted into the environment. Given the use of red flashing lights and the ADLS, only non-measurable **negligible** impacts, if any, to individuals or populations would be expected.	permanent near the coast, but minimal offshore. Future offshore wind activities could cause impacts on birds through this sub-IPF if BOEM and FAA lighting guidance is not followed. This sub-IPF would have **negligible**, non-measurable cumulative impacts on birds that would be attributed to the Proposed Action, although ongoing and future non-offshore wind activities are expected to cause permanent impacts, primarily driven by light from onshore structures.
New cable emplacement/ maintenance	New cable emplacement and cable maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be temporary and generally limited to the emplacement corridor. Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances will be temporary and limited to the emplacement corridor. In the cumulative impact geographic analysis area, there are six existing power cables. See BOEM (2019b) for details. Direct impacts from suspended sediment include reduced foraging success, as vision is an important component of seabird foraging activity (Cook and Burton 2010). Additionally, impacts may occur as a result of impacts on prey species. However, given the localized nature of the potential impacts, individuals would be expected to successfully forage in nearby areas not affected by increased sedimentation and no biologically significant impacts on individuals or populations would be expected.	Future new cables, perhaps connecting Martha's Vineyard and/or Nantucket to the mainland, would occasionally disturb the seafloor and cause temporary increases in suspended sediment, resulting in localized, short-term impacts. The FCC has two pending submarine telecommunications cable applications in the North Atlantic. Impacts would be temporary and localized, with no biologically significant impacts on individuals or populations.	Assuming similar installation procedures as the proposed Project, the duration and range of impacts would be limited spatially and temporally. Impacts would occur during construction and would involve increased turbidity for 1 to 6 hours at a time. Short-term impacts on foraging individuals could occur in the immediate vicinity of installation activities. No biologically significant impacts on individuals or populations would be expected.	The Proposed Action would cause short-term disturbances during construction and possibly during operations and maintenance. The Proposed Action estimated that up to 328 acres (1.3 km^2) of sea floor could be disturbed by cable installation and that up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation, potentially leading to short-term impacts including reduced foraging success and displacement (Cook and Burton 2010). Cable installation would mostly be done by jet or mechanical plow. Dredged material disposal could increase suspended sediment concentrations to more than 1,000 mg/L for a duration of less than 2 hours and approximately 3 miles (5 kilometers). However, individuals would be expected to successfully forage in nearby areas not affected by increased sedimentation and only non-measurable **negligible** impacts, if any, would be expected on individuals or populations.	The Proposed Action estimated that up to 328 acres (1.3 km^2) of sea floor could be disturbed by cable installation and that up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation, potentially leading to short-term, **negligible** impacts due to reduced foraging success and displacement, although no biologically significant impacts would be expected. Ongoing and future non-offshore wind activities—if any involve this IPF—may cause local, short-term impacts. Future offshore wind activities other than the proposed Project would disturb up to 7,037 acres (28.5 km^2). No measurable cumulative impacts on birds would be attributed to the Proposed Action. Some level of cumulative impacts arising from future development, including future offshore wind, could occur if impacts are in close temporal and spatial proximity. Although these impacts would be **negligible**, they would not be expected to be biologically significant.
Noise: Aircraft	Aircraft routinely travel in the geographic analysis area for birds. With the possible exception of rescue operations and survey aircraft, no ongoing aircraft flights would occur at altitudes that would elicit a response from birds. If flights are at a sufficiently low altitude, birds may flush, resulting in non-biologically significant increased energy expenditure. Disturbance, if any, would be localized and temporary and impacts would be expected to dissipate once the aircraft has left the area.	Aircraft noise is likely to continue to increase as commercial air traffic increases; however, very few flights would be expected to be at a sufficiently low altitude to elicit a response from birds. If flights are at a sufficiently low altitude, birds may flush, resulting in non-biologically significant increased energy expenditure. Disturbance, if any, would be localized and temporary and impacts would be expected to dissipate once the aircraft has left the area.	Offshore wind projects may use aircraft for crew transport during construction and/or maintenance over the next 30 years. Aircraft will continue to be used for pre-construction surveys and wildlife monitoring. The level of use would be low and restrictions on low-flying aircraft may be imposed. No individual fitness or population-level impacts would be expected.	Vineyard Wind may use aircraft for crew transport during maintenance over the life of the Proposed Action. Additionally, aircraft would be used to conduct Project-level wildlife surveys, which could amount to as many as 30 flights per year. These flights may result in non-biologically significant increased energy expenditure due to flushing in response to aircraft overflights. Any disturbance would be intermittent, localized, and affect only a few individuals. As such, impacts, if any, would be **negligible**.	The impacts on birds from this sub-IPF under the Proposed Action could include **negligible** non-biologically significant increased energy expenditure due to flushing in response to aircraft overflights. However, flights associated with the Proposed Action would be limited, and only a few individuals would be exposed. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature, but across a greater spatial and temporal extent. Future offshore wind activities would likely result in many more aircraft flights than the Proposed Action, but the overall impacts on individuals would still be considered low, and no biologically significant impacts would be expected. Cumulatively, the impacts on birds through this sub-IPF associated with the Proposed Action and past, present, and reasonably foreseeable activities are expected to be short-term and localized, with non-biologically significant **negligible** impacts expected to result. The Proposed Action would have little-to-no influence on cumulative impacts through this sub-IPF.
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities could result in impacts on diving birds due to displacement by the use of active acoustic equipment and other active acoustic equipment. Non-diving birds would be unaffected. Any displacement would only be temporary during non-migratory periods, but impacts could be greater if displacement were to occur in preferred feeding areas during seasonal migration periods.	Same as ongoing activities, with the addition of possible future oil and gas surveys.	Site characterization surveys for offshore wind facilities would create intermittent, high-intensity impulsive noise around investigation sites over a 2- to 10-year period. These activities could result in impacts on diving birds due to displacement by the use of active acoustic equipment and other active acoustic equipment. Non-diving birds would be unaffected. Any displacement would only be temporary during non-migratory periods, but impacts could be greater if displacement occurred in preferred feeding areas during seasonal migration periods.	Noise from G&G surveys during inspection and/or monitoring of cable routes may occur during construction and operations. G&G noise resulting from cable route surveys may be less intense than G&G noise from site investigation surveys in WDAs. Impacts, if any, are anticipated to be temporary and **negligible** during non-migratory periods, but impacts could be greater if G&G noise occurs in preferred feeding areas during seasonal migration periods, although impacts would still be **negligible**.	G&G survey noise from the Proposed Action may result in temporary **negligible** impacts, (displacement of diving birds) along the cable routes during inspections. Impacts could have higher consequences, although still **negligible**, if G&G surveys occur during seasonal migration periods. Ongoing and future non-offshore wind impacts may result in similar types of impacts as the Proposed Action over an unknown extent. Future offshore wind development, excluding the proposed Project, would likely affect a much greater area than the Proposed Action would. **Negligible** to **minor** cumulative impacts associated with the Proposed Action and past, present, and reasonably foreseeable activities would likely be approximately equal to, or slightly less than, the sum of these impacts.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water could result in intermittent, temporary, localized impacts on diving birds due to displacement from foraging areas if birds are present in the vicinity of pile-driving activity. The extent of these impacts depends on pile size, hammer energy, and local acoustic conditions. No biologically significant impacts on individuals or populations would be expected.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Noise from pile driving would occur during installation of foundations for offshore structures for 4 to 6 hours at a time over a 6- to 12-year period. Noise transmitted through water could result in localized, intermittent, temporary impacts on diving birds due to displacement from foraging areas if birds are present in the vicinity of pile driving activity. No biologically significant impacts on individuals or populations would be expected.	Noise from pile driving would occur during foundation installations for 4 to 6 hours at a time. If birds are present in the vicinity of pile driving activity, noise transmitted through water could result in localized, intermittent, temporary, **negligible** impacts on diving birds due to displacement from foraging areas. No biologically significant impacts on individuals or populations would be expected.	The Proposed Action is expected to cause non-biologically significant, localized, short-term, **negligible** impacts, resulting in temporary displacement of individual diving birds. Ongoing and future non-offshore wind activities may have similar impacts, perhaps with a smaller extent, with a majority of impacts occurring in nearshore waters. Future offshore wind activities excluding the proposed Project could cause similar impacts, but over a greater temporal and spatial scale. **Negligible** cumulative impacts associated with the Proposed Action and past, present, and reasonably foreseeable activities, equal to the sum of these impacts, if any, would not be expected to be biologically significant and no noticeable change to the condition of birds in the analysis are anticipated.
Noise: Onshore construction	Onshore construction is routinely used in generic infrastructure projects. Equipment could potentially cause displacement. Any displacement would only be temporary and no individual fitness or population-level impacts would be expected.	Onshore construction will continue at current trends. Some behavior responses could range from escape behavior to mild annoyance, but no individual injury or mortality would be expected.	Onshore construction could take place to install onshore transmission cable and, in the rare occasion, to make repairs. This activity would occur intermittently in the geographic analysis area for birds. Some behavior responses could range from escape behavior to mild annoyance, but no individual injury or mortality would be expected.	All onshore construction required for the Proposed Action would occur in previously disturbed areas. The Proposed Action is expected to cause localized and short-term, **negligible** impacts, resulting in non-biologically significant behavioral responses.	Onshore construction associated with the Proposed Action is expected to cause localized, short-term, **negligible** impacts, resulting in non-biologically significant behavioral responses. Onshore impacts from ongoing and non-offshore activities are expected to result in the same non-biologically significant behavior responses, but across a greater temporal and spatial scale. Future offshore wind, excluding the proposed Project, would also be expected to cause only non-biologically significant behavior responses. **Negligible** cumulative impacts associated with the Proposed Action and past, present, and reasonably foreseeable activities, equal to the sum of these impacts, are anticipated to result in no noticeable change to the condition of birds in the geographic analysis area.
Noise: Vessels	See Section 3.13 for noise impacts from vessels. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Sub-surface noise from vessels could disturbed diving birds foraging for prey below the surface. The consequence to birds would be similar to noise from G&G but likely less because noise levels are lower.	See Section 3.13 for noise impacts from vessels.	Vessel noise associated with future offshore wind development could disturb some individuals, but they would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (BOEM 2012a). However, brief, temporary responses, if any, would be expected to dissipate once the vessel has passed or the individual has moved away. No individual fitness or population-level impacts would be expected.	Vessel noise associated with the Proposed Action could disturb offshore bird species, but they would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (BOEM 2012a). Brief, temporary responses, if any, would be expected to dissipate once the vessel has passed or the individual has moved away. Non-measurable **negligible** impacts, if any, to individuals or populations would be expected.	Vessel noise from the Proposed Action is anticipated to cause small, temporary, localized, non-measurable **negligible** impacts on birds, if any. Vessel noise from ongoing activities and future non-offshore wind activities is also expected to cause small, temporary, localized impacts on birds. Vessel noise from future offshore wind activities excluding the proposed Project is also expected to cause small, temporary, localized impacts birds. **Negligible** cumulative impacts associated with the Proposed Action and past, present, and reasonably foreseeable activities, equal to the sum of these impacts, are anticipated to result in no noticeable change to the condition of birds in the geographic analysis area.
Presence of structures: Entanglement, gear loss, gear damage	Each year, 2,551 seabirds die from interactions with U.S. commercial fisheries on the Atlantic (Sigourney et al. 2019). Even more die due to abandoned commercial fishing gear (nets); a reduction in derelict fishing gear has a beneficial impact on bird populations (Regular et al. 2013). In addition, recreational fishing gear (hooks and lines) is periodically lost on existing buoys, pilings, hard protection, and other structures and has the potential to entangle birds.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Development of the projects in the expanded cumulative scenario would install more buoys and foundations. The installation of 2,066 foundations increases the chance that drifting derelict gear becomes immobilized and thus reduces the chance that the abandoned gear will cause additional harm to birds and other wildlife. While debris tangled with foundations may still pose a hazard to marine life including birds, implementation of surveys and gear removal would further reduce potential long-term intermittent risk.	The Proposed Action is expected to add up to 102 foundations increasing the chance that drifting derelict gear becomes immobilized and thus reducing the chance that the abandoned gear will cause additional harm to birds and other wildlife. While debris tangled with foundations may still pose a hazard to marine life including birds, implementation of surveys and gear removal would further reduce potential long-term intermittent risk. Additionally, impacts due to gear entanglement from recreational fishing near the structures would likely be localized, short-term, and difficult to detect, although the risk of occurrence would persist as long as the structures remain. The proposed measure of annual remotely operated, underwater vehicle surveys, reporting, and monofilament and other fishing-gear cleanup around WTG foundations would minimize the potential for impacts on birds. As such, impacts, if any would be expected to be **negligible**.	The risk of impacts from this sub-IPF is proportional to the amount of structures present. The Proposed Action would add up to 102 foundations, which could lead to **negligible** impacts including injury or mortality due to recreational fishing. Ongoing entanglement and gear loss/damage at existing structures also periodically results in localized, short-term impacts. Future offshore wind activities, not including the proposed Project, would add approximately 2,737 acres (11 km^2) of scour/cable protection and the vertical surfaces of up to 2,066 new foundations. Cumulatively, up to 2,066 foundations associated with the Proposed Action and past, present, and reasonably foreseeable activities could immobilize drifting derelict fishing gear plus the implementation of surveys and gear removal would further reduce the expected **negligible** potential long-term intermittent risk with **beneficial** impacts.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these locations. These impacts are local and can be short-term to permanent. These fish aggregations can provide localized, short-term to permanent, beneficial impacts on some bird species due to increased prey species availability. Likewise, structures may attract recreational fishing.	New cables, installed incrementally in the next 20 to 30 years, would likely require hard protection atop portions of the cables (see New cable emplacement/ maintenance row). Any new towers, buoys, or piers would also create uncommon relief in a mostly flat seascape. Structure-oriented fishes could be attracted to these locations. Abundance of certain fishes may increase. These impacts are expected to be local and may	A total of 2,066 new structures, added intermittently over an assumed 6- to 10-year period, could attract structure-oriented fishes while the structures remain. Abundance of certain fishes may increase and result in increased foraging opportunities for some bird species. Recreational fishing, both personal and for-hire, may also increase, which could lead to impacts on birds (see Presence of Structures: Entanglement, gear loss/damage row). These impacts are expected to be local and may be short-term to permanent.	A total of 102 new structures and 151 acres (0.6 km^2) of scour/cable protection would be added. Foundations would remain for the life of the Proposed Action, and scour/cable protection would permanently remain until decommissioning. Structure-oriented fishes could be attracted to these locations. Abundance of certain fishes may increase and result in increased foraging opportunities for some bird species, leading to **minor beneficial** impacts. Recreational fishing, both personal and for-hire, may also increase, which could lead to **negligible** impacts on birds	The installation of 102 new structures and 151 acres (0.6 km^2) of scour/cable protection associated with the Proposed Action is expected to cause localized impacts on birds that may be either short-term to permanent and may be **beneficial** or **adverse**. Existing structures and future non-offshore wind structures are expected to cause similar localized impacts on birds through this sub-IPF. The estimated 2,066 offshore wind structures other than those associated with the Proposed Action are also expected to cause similar localized impacts on birds through this sub-IPF. Cumulatively, this sub-IPF is anticipated to cause many localized, short-term to permanent, **negligible** impacts associated with the Proposed Action and past, present, and reasonably foreseeable activities. BOEM does not anticipate that this

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
		be short-term to permanent. These fish aggregations can provide localized, short-term to permanent beneficial impacts on some bird species due to increased prey species availability.		(see Presence of Structures: Entanglement, gear loss/damage row). These impacts are expected to be local and may be short-term to permanent.	sub-IPF would result in considerable changes in bird distributions across the geographic analysis area for birds.
Presence of structures: Migration disturbances	A few structures are scattered about the offshore geographic analysis area for birds. The area includes an assortment of navigation and weather buoys plus a handful of light towers (NOAA 2020). Migrating birds can easily fly around or over these sparely distributed structures.	The infrequent installation of future new structures in the marine environment over the next 30 years would not be expected to result in migration disturbances.	Offshore wind-related activities would add up to 2,066 structures (turbines and ESPs) plus buoys. Based on the assumption that structures would be spaced 1 nautical mile (1.9 kilometers) apart, ample space between WTGs would allow birds that are not flying above WTGs to fly through without changing course or to make minor course corrections to avoid operating WTGs. Course corrections made by migratory birds to avoid a project or individual WTG would be relatively minor when compared to the distances traveled during seasonal migrations. Impacts, if any, resulting from additional energy expenditure would not be expected to result in individual fitness or population-level impacts.	Up to 100 turbines plus two ESPs could be installed that would remain for the life of the Proposed Action. Most birds that are not flying above the towers would be able to fly between individual towers or make minor course corrections. Course corrections made by migratory birds to avoid individual operating WTGs would be relatively minor when compared to the distances traveled during seasonal migrations. Similarly, some species may avoid the entire WDA during migration; however, impacts, if any, resulting from additional energy expenditure would be expected to result in non-measurable, negligible impacts and no individual fitness or population-level impacts would be expected.	The non-measurable, negligible impacts on birds from this sub-IPF under the Proposed Action could include non-biologically significant increased energy expenditure due to minor course correction to avoid individual WTGs or the entire WDA. Ongoing activities and future non-offshore wind would not be expected to have any impacts on migrating birds. Offshore structures associated with future offshore wind (excluding the proposed Project) would likely result in multiple and/or larger-scale course corrections, but the overall impacts on individuals would still be considered low, and no biologically significant impacts would be expected. Cumulatively, the impacts on birds through this sub-IPF associated with the Proposed Action and past, present, and reasonably foreseeable activities are expected to be long-term but localized, with non-biologically significant negligible impacts expected to result. The Proposed Action would have little to no influence on cumulative impacts through this sub-IPF.
Presence of structures: Turbine strikes, displacement, and attraction	A few structures are in the offshore geographic analysis area for birds. The area has an assortment of navigation and weather buoys plus a handful of light towers (NOAA 2020). Given the limited number of structures currently in the geographic analysis area, individual- and population-level impacts due to displacement from current foraging habitat would not be expected. Stationary structures in the offshore environment would not be expected to pose a collision risk to birds. Some birds like cormorants and gulls may be attracted to these structures and opportunistically roost on these structures.	The infrequent installation of future new structures in the marine environment over the next 30 years would not be expected to result in an increase in collision risk or to result in displacement. Some potential for attraction and opportunistic roosting exists, but would be expected to be limited given the limited anticipated number of structures.	Offshore wind development would add up to 2,066 structures (turbines and ESPs) plus buoys. Individual WTG and project spacing would allow individuals to avoid individual operating WTGs, individual offshore wind facilities, or all offshore lease areas, resulting in non-biologically significant increased energy expenditure. The greatest risk to birds associated with future offshore wind development is expected to be fatal interactions with operating WTGs. Some level of mortality can be assumed at future operating offshore wind facilities, though migrating and/or foraging individuals would not be exposed to all the proposed projects, and no population-level impacts would be expected. Based on the mortality rate of 6.9 birds per turbine in the Eastern United States (Loss et al. 2013), an estimated 13,945 birds could be killed annually due to the 2,021 WTGs anticipated under the cumulative impact scenario. Collision risk models predict that 75 marine birds would be killed annually. The addition of WTGs to the offshore environment would result in increased functional loss of habitat for those species with higher displacement sensitivity; however, as described in the Draft EIS, substantial foraging habitat for resident birds would remain available outside the proposed offshore lease areas, and no individual fitness or population-level impacts would be expected to occur. Some potential for attraction and opportunistic roosting on new structures associated with future offshore wind development exists, and could result in increased exposure to operating WTGs.	Up to 100 turbines and two ESPs could be installed. Birds that are not flying above WTGs would be able to fly between individual towers or make minor course corrections. Course corrections made by migratory birds to avoid individual WTG, or the entire proposed Vineyard Wind 1 Project area, would be relatively minor when compared to the distances traveled during seasonal migrations. Impacts, if any, resulting from additional energy expenditure would be negligible and would not be expected to result in individual fitness or population-level impacts. Given the known annual mortality of 234,000 birds at terrestrial wind facilities, some mortality due to the Proposed Action could occur, though use of the WDA by those species with higher collision sensitivity is expected to be low, resulting in negligible to minor impacts (Figure 3.3.2-1 in the Draft EIS). For those species with higher displacement sensitivity, the WDA will no longer provide suitable foraging habitat; however, foraging habitat exists outside the WDA and would remain available. Some potential for attraction and opportunistic roosting on new structures associated with future offshore wind development exists, and could result in increased exposure to operating WTGs.	Some turbine strikes could occur as a result of the Proposed Action, though the extent to which this mortality would affect resident and migrant populations of birds is unclear at this time. Given the low expected use of the WDA, these impacts would be negligible to minor. Those species with higher displacement sensitivity would be expected to avoid the Proposed Action, resulting in non-measurable negligible impacts. Ongoing and future non-offshore wind activities would not have any impact on birds. WTGs associated with future offshore wind (excluding the Proposed Action) would be expected to result in a greater number of strikes due to the much larger number of WTGs. Similarly, under the full buildout scenario, a much larger area of habitat will be unavailable to foraging individuals of species with higher displacement sensitivity. Cumulatively, most of the assumed WTG strikes associated with the Proposed Action and past, present, and reasonably foreseeable activities would be attributed to future offshore wind development (excluding the Proposed Action) and those impacts are expected to range from minor to moderate. Negligible cumulative impacts would be expected from displacement due to the presence of structures on the OCS.
Traffic: Aircraft	General aviation accounts for approximately two bird strikes per 100,000 flights (Dolbeer et al. 2019). Additionally, aircraft are used for scientific and academic surveys in marine environments.	Bird fatalities associated with general aviation would be expected to increase with the current trend in commercial air travel. Aircraft will continue to be used to conduct scientific research studies as well as wildlife monitoring and pre-construction surveys. These flights would be well below the 100,000 flights and no bird strikes would be expected to occur.	Aircraft will continue to be used to at the same rate to conduct wildlife surveys during the post-construction phase. The amount of flight activity is not expected to change from current levels. Aircraft may be used to transport construction, operations, and maintenance crews. The level of use would be modest and well below 100,000 flights per year; therefore, bird strikes due to flights associated with future offshore wind development are expected to be highly unlikely.	Aircraft would be used to conduct Project-level wildlife surveys, which could amount to a dozen or two flights per year. Additionally, aircraft may be used to transport construction and maintenance crews. The number of flights for transport and surveys would be well below 100,000 flights and bird strikes from Project-related flights are expected to be negligible and highly unlikely.	The Proposed Action would lead to negligible impacts on birds for this sub-IPF. Ongoing and future non-offshore wind developments are expected to continue at current levels and two bird strikes per 100,000 flights would be expected to continue. Future offshore wind developments would not be expected to lead to any impacts for this sub-IPF. Cumulatively, the Proposed Action and future offshore wind development would have little to no influence and negligible cumulative impacts on birds relative to this sub-IPF.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Land disturbance: Onshore construction	Onshore construction activity will continue at current trends. There is some potential for indirect impacts associated with habitat loss and fragmentation. No individual or population-level impacts would be expected.	Future non-offshore wind development would continue to occur at the current rate. This development has the potential to result in habitat loss, but would not be expected to result in injury or mortality of individuals.	A small amount of construction impacts associated with onshore power infrastructure would be required to tie future offshore wind energy projects to the electric grid. Typically, this would require only small amounts of habitat removal, if any. As such, this sub-IPF is not expected to appreciably contribute to impacts on birds.	The Vineyard Wind 1 Project would require temporary habitat alteration within existing public utility ROW. Clearing, grading, and excavations would temporarily alter existing habitat, which is primarily grassland and small shrubs. The noise generated by construction activities, as well as the physical changes to the space, could render an area temporarily unsuitable for birds. Given the nature of the existing habitat, its abundance on the landscape, and the temporary nature of construction, the temporary impacts on bird species that frequent this forest edge/managed grassland ecosystem are expected to be **negligible**.	Onshore construction associated with the Proposed Action is expected to cause localized, short-term, **negligible** impacts, resulting in non-biologically significant behavioral responses. Onshore impacts from ongoing and non-offshore activities are expected to result in the same non-biologically significant behavior responses, but across a greater temporal and spatial scale. Future offshore wind, excluding the proposed Project, would also be expect to cause only non-biologically significant behavioral responses. **Negligible** cumulative impacts associated with the Proposed Action and past, present, and reasonably foreseeable activities, equal to the sum of these impacts, are anticipated to result in no noticeable change to the condition of birds in the geographic analysis area.
Climate change: Warming and sea level rise, storm severity/frequency	Increased storm frequency and severity during the breeding season can reduce productivity of bird nesting colonies and kill adults, eggs, and chicks.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Impacts are the same as under Ongoing Activities for this sub-IPF. See Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities for this sub-IPF. See Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to reduced growth or the decline of bird prey resources. Because this sub-IPF is a global phenomenon, impacts on birds though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Section A.8.1 for the cumulative contribution of these activities to climate change.
Climate change: Ocean acidification	Increasing ocean acidification may affect prey species upon which some birds feed and could lead to shifts in prey distribution and abundance. Intensity of impacts on birds is speculative.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities for this sub-IPF. See Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to reduced growth or the decline of bird prey resources and may lead to impacts on prey abundance and distribution. Because this sub-IPF is a global phenomenon, impacts on birds though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Section A.8.1 for the cumulative contribution of these activities to climate change.
Climate change: Warming and sea level rise, altered habitat/ecology	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 30 years, influencing the distribution of bird prey resources.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Impacts are the same as under Ongoing Activities for this sub-IPF. See Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities for this sub-IPF. See Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to reduced growth or the decline of bird prey resources and may lead to impacts on prey abundance and distribution. Because this sub-IPF is a global phenomenon, impacts on birds though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Section A.8.1 for the cumulative contribution of these activities to climate change.
Climate change: Warming and sea level rise, altered migration patterns	Birds rely on cues from the weather to start migration. Wind direction and speed influence the amount of energy used during migration. For nocturnal migrants, wind assistance is projected to increase across eastern portions of the continent (0.32 m/s; 9.6%) during spring migration by 2091, and wind assistance is projected to decrease within eastern portions of the continent (0.17 m/s; 6.6%) during autumn migration (Sorte et al. 2019).	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Impacts are the same as under Ongoing Activities for this sub-IPF. See Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities for this sub-IPF. See Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to impacts through changes to cues related to migration timing and the potential for wind assistance during migration periods. Because this sub-IPF is a global phenomenon, impacts on birds though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Section A.8.1 for the cumulative contribution of these activities to climate change.
Climate change: Warming and sea level rise, property/ infrastructure damage	This sub-IPF would have no impacts on birds.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Impacts are the same as under Ongoing Activities for this sub-IPF. See Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities for this sub-IPF. See Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF would not contribute to direct, indirect, or cumulative impacts on birds.
Climate change: Warming and sea level rise, protective measures (barriers, seawalls)	The proliferation of coastline protections have the potential to result in long-term, high-consequence, impacts on bird nesting habitat.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Impacts are the same as under Ongoing Activities for this sub-IPF. See Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities for this sub-IPF. See Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to impacts through loss or modification of currently suitable nesting habitat. Because this sub-IPF is a global phenomenon, impacts on birds though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Section A.8.1 for the cumulative contribution of these activities to climate change.
Climate change: Warming and sea level rise, increased disease frequency	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 30 years, influencing the frequencies and distributions of various diseases of birds.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.	Impacts are the same as under Ongoing Activities for this sub-IPF. See Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities for this sub-IPF. See Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to changes in the frequency and distribution of bird diseases. Because this sub-IPF is a global phenomenon, impacts on birds through this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Section A.8.1 for the cumulative contribution of these activities to climate change.

ADLS = Aircraft Detection Light System; BMP = best management practice; BOEM = Bureau of Ocean Energy Management; EIS = Environmental Impact Statement; ESP = electrical service platform; FAA = Federal Aviation Administration; FCC = Federal Communications Commission; G&G = Geological and Geophysical; GHG = greenhouse gas; IPF = impact-producing factors; km2 = square kilometers; mg/L = milligrams per liter; m/s = meter per second; NOAA = National Oceanic and Atmospheric Administration; OCS = outer continental shelf; ROW = right-of-way; USCG = U.S. Coast Guard; WDA = wind development area; WTG = wind turbine generator

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A.8.4. Bats

A.8.4.1. No Action Alternative Impacts

Table A-12 contains a detailed summary of the baseline conditions and the impacts of ongoing and future offshore activities other than offshore wind on bats, based on the IPFs assessed. This information comes from the Draft EIS, supplemented by information developed in responding to comments on the Draft EIS, from the USFWS, and additional information. The impact analysis is limited to the impacts within the geographic analysis area for bats as described in Table A-1 and shown on Figure A.7-16.

Bats are terrestrial species that spend almost their entire lives on or over land. On occasion, tree bats may potentially occur offshore during spring and fall migration and under very specific conditions like low wind and high temperatures. Use of the OCS by tree bats is expected to be very low and limited to spring and fall migration periods. All eight species of bats that occur in coastal Massachusetts, including the Northern long-eared bat, may be present near the onshore facilities. Within the geographic analysis area for bats, from New York to Maine, cave bat species, such as Northern long-eared bat, are experiencing drastic declines due to white-nose syndrome, a fungal bat disease in the United States resulting in mortality as high as 90 percent at some hibernation sites (Blehart et al. 2009; Gargas et al. 2009; Turner et al. 2011). Unlike tree bats, the likelihood of detecting a cave bat is substantially less in offshore areas (Pelletier et al. 2013). Regionally, both resident and migrant cave bat species occur on islands within Nantucket Sound, indicating that over-water crossings do occur (MMS 2008). Offshore movements of cave bats (but not Northern long-eared bats) have been detected during fall migration, but in all cases were directed toward the mainland (Dowling et al. 2017).

Bats within the geographic analysis area are subject to pressure from ongoing activities, generally associated with onshore impacts, including onshore construction and climate change. Onshore construction activities, and associated impacts, are expected to continue at current trends and have the potential to result in direct and indirect impacts on bat species. Impacts associated with climate change have the potential to reduce reproductive output, increase individual mortality and disease occurrence (Table A-12). Ongoing impacts from onshore construction activities would continue regardless of the offshore wind industry.

Under the No Action Alternative, the proposed Project would not be built and hence would have no bat impact. However, impacts from ongoing, future non-offshore wind, and future offshore wind activities would still occur. If the Vineyard Wind 1 Project is not approved, then impacts from the proposed Project would not occur as proposed. However, the state demand that the Vineyard Wind 1 Project would have filled if approved, could likely be met by other projects in the geographic analysis area for bats. Therefore, the impacts on bats would be similar, but the exact impact 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 and considers the assumptions included in Section 1.2 of this SEIS and here in Appendix A. A detailed analysis of impacts associated with future offshore wind development is provided in Section A.8.4.1.1 and summarized in Table A-12. Cumulative impacts of the Proposed Action and action alternatives are analyzed in Section A.8.4.2.

A.8.4.1.1 Future Offshore Wind Activities (without Proposed Action)

BOEM expects these future offshore wind activities to affect bats through the following primary IPFs.

Noise: Anthropogenic noise on the OCS associated with future offshore wind development, including noise from pile-driving and construction activities, has the potential to impact bats on the OCS. Additionally, onshore construction noise has the potential to impact bats. BOEM anticipates that these impacts would be temporary and highly localized.

In the expanded cumulative scenario, in Table A-4, the construction of 2,066 offshore structures would create noise and may temporarily impact some migrating tree bats, if conducted at night during spring or fall migration. The greatest impact of noise is likely to be caused by pile-driving activities during construction. Noise from pile driving would occur during installation of foundations for offshore structures at a frequency of 4 to 6 hours at a time over a 6- to 12-year period. Under a maximum-case scenario, construction would occur 24 hours per day. Construction activity would be short-term, temporary, and highly localized. Direct impacts are not expected to occur as recent research has shown that bats may be less sensitive to temporary threshold shifts than other terrestrial mammals (Simmons et al. 2016). Indirect impacts (i.e., displacement from potentially suitable habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior by individual migrating tree bats (Schaub et al. 2008). These impacts would be expected to be limited to behavioral avoidance of pile-driving and/or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016). However, these impacts are highly unlikely to occur as little use of the OCS is expected, and only during spring and fall migration.

Some potential for short-term, temporary, localized indirect impacts arising from onshore construction noise exists, however, no direct impacts on bats would be expected to occur. Recent literature suggests that bats are less susceptible to temporary or permanent hearing loss due to exposure to intense sounds (Simmons et al. 2016). Impacts are expected to be limited to individuals roosting adjacent to onshore construction locations. Nighttime work may be required on an as-needed basis. Some temporary displacement and/or avoidance of potentially suitable foraging habitat could occur, but these impacts would not be expected to be biologically significant. Some bats roosting in the vicinity of construction activities may be disturbed during construction but would be expected to move to a different roost further from construction noise. This would not be expected to result in any impacts as frequent roost switching is a common among bats (Hann et al. 2017; Whitaker 1998). Given the temporary and localized nature of potential impacts and the expected biologically insignificant response to those impacts, no individual fitness or population-level impacts would be expected to occur as a result of onshore noise associated with future offshore wind development.

Presence of structures: Using the assumptions in Table A-4, the expanded cumulative scenario would include up to 2,021 WTGs on the OCS that could result in potential impacts on migration patterns and pose an increased collision risk to individual tree bats. Additionally it is possible that some bats may use the expected 2,066 structures (ESPs and WTG towers) to opportunistically roost. As stated in the Draft EIS, bat use of the offshore is very limited and generally restricted to spring and fall migration. Given the infrequent and limited expected use of the OCS by migrating bats, very few individuals would be expected to encounter operating WTGs or other structures associated with future offshore wind development. With the proposed one-nautical mile (1.9-kilometer) spacing between structures associated with future offshore wind development and the distribution of anticipated projects, individual bats migrating over the OCS within the rotor swept area of project WTGs would likely pass through projects with only slight course corrections, if any, to avoid operating WTGs. The potential collision risk to migrating tree bats varies with climatic conditions, and unlike terrestrial migration routes, there are no landscape features that would concentrate migrating tree bats and increase exposure to WDAs on the OCS. Given the rarity of tree bats in the offshore environment, the turbines being widely spaced, and the patchiness of projects, the likelihood of collisions is expected to be low. Additionally, the likelihood of a migrating individual encountering one or more operating WTGs during adverse weather conditions is extremely low.

Land disturbance: A small amount of infrequent construction impacts associated with onshore power infrastructure would be required over the next 6- to 10- years to tie future offshore wind energy projects to the electric grid. Typically, this would require only small amounts of habitat removal, if any, and would occur in previously disturbed areas. Short-term, temporary, indirect impacts associated with habitat loss or avoidance during construction may occur, but no injury or mortality of individuals would be expected. As such, onshore construction activities associated with future offshore wind development would not be expected to appreciably contribute to overall impacts on bats.

In addition to electrical infrastructure, some amount of habitat conversion may result from port expansion activities required to meet the demands for fabrication, construction, transportation, and installation of wind energy structures. The general trend along the coastal region from Virginia to Maine is that port activity will increase modestly and require some conversion of undeveloped land to meet port demand. This conversion will result in permanent habitat loss for local bat populations. However, the incremental increase from future offshore wind development will be a minimal contribution in the port expansion required to meet increased commercial, industrial, and recreational demand (BOEM 2019a). The current bearing capacity of existing ports was considered suitable for wind turbines, requiring no port modifications for supporting offshore wind energy development (DOE 2014).

Climate change: IPFs related to climate change, including increased storm severity/frequency and increased disease frequency, have some potential to result in impacts on bats, though the intensity and extent of these potential impacts are speculative at this time. However, future offshore wind development would not be expected to contribute to climate change impacts on bats. A discussion of activities that contribute to climate change IPFs are provided in Section A.8.1.

A.8.4.1.2 Conclusions

The proposed Project would not be built under the No Action Alternative and hence would not itself have any adverse impacts on bats. BOEM expects ongoing activities, future non-offshore wind development, and future offshore wind development to have continuing temporary to permanent impacts on bats primarily through the onshore construction impacts and climate change.

Considering all the IPFs together, BOEM anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in **minor** adverse impacts because of ongoing climate change and onshore habitat loss. Future offshore wind activities are not expected to materially contribute to the IPFs discussed above. Given the infrequent and limited anticipated use of the OCS by migrating tree bats during spring and fall migration, and given that cave bats do not typically occur on the OCS, none of the IPFs associated with future offshore wind activities that occur offshore would be expected to appreciably contribute to overall impacts on bats. Some potential for temporary disturbance and permanent loss of onshore habitat may occur as a result of future offshore wind development. However, habitat removal is anticipated to be minimal when compared with other past, present, and reasonably foreseeable activities, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area.

Under the No Action Alternative, there would be no impacts on bats related to the construction, operations, or decommissioning of the proposed Project (described in Draft EIS Section 3.3.3.3), which would not be built. Bats would continue to follow current regional trends and respond to current and future environmental and societal activities.

A.8.4.2. Proposed Action and Action Alternatives

A.8.4.2.1 Cumulative Impacts of the Proposed Action

The direct and indirect impacts of the Proposed Action on bats are described in Draft EIS Section 3.3.3.3 and additional information is provided in Table A-12. The Proposed Action would likely result in impacts that are expected to be localized and range from short-term and temporary to permanent. No individual fitness or population-level impacts on bats would be expected to occur.

The Draft EIS did not describe the potential for climate change related sub-IPFs to result in impacts on bat species. Generally, BOEM anticipates that impacts arising from climate change IPFs would be limited to increased storm frequency and severity and increased disease frequency (Table A-12). More frequent and/or severe storms arising from changing climate conditions may result in more frequent and widespread direct and indirect impacts on bats as a result of habitat destruction and direct mortality. Additionally, storms that occur over the OCS during spring and fall migration could potentially result in impacts on migrating individuals that would not be able to take shelter and cause injury and/or mortality. However, as described above, very few individuals would be expected over the OCS during spring and fall migration, and no population-level effects would be expected.

Changes to the design capacity of the WTGs proposed in the Vineyard Wind COP (Epsilon 2020) would not alter the maximum-case scenario of potential impacts on bats for the Proposed Action and all other action alternatives because the maximum-case scenario involves the maximum number of WTGs in the PDE. Changes to the proposed onshore substation site could modify the impacts of the Proposed Action and all other action alternatives on bats. The Draft EIS assessed the potential impacts of building a substation of up to 7 acres (0.03 km^2) in size within a completely forested site. Vineyard Wind has increased the substation site area to 8.7 acres (0.04 km^2), of which only 7.7 acres (0.03 km^2) would involve ground disturbance, and could result in a slight increase in temporary displacement, habitat degradation, and potential injury or mortality of bats during construction activities. Of the 7.7 acres (0.03 km^2) of ground disturbance, only 6.1 acres (0.02 km^2) would involve tree clearing, which is only slightly larger than the 5.9 acres (0.02 km^2) of forest removal assessed in Draft EIS Section 3.3.3.3. Considering these changes, the direct and indirect impacts of the Proposed Action and all other action alternatives on bats through land disturbance are still expected to be **negligible**.

The cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities would be similar to those described in Section A.8.4.1, but may differ in intensity and extent. It is assumed that the energy demand that the Vineyard Wind 1 Project would fill (if approved) would likely be met by other projects in remaining areas of the Massachusetts, Rhode Island, and/or New York leases (if not approved). Although the impacts from a substitute project may differ in location and time, depending on where and when offshore wind facilities are developed to meet the remaining demand, the nature of impacts and the total number of WTGs would be similar either with or without the Proposed Action, as described in Section A.8.4.1. In other words, future offshore wind facilities capable of generating 9,404 MW would be built in the RI and MA Lease Areas, although in the absence of the Proposed Action, none would be built before 2021.

Noise: The expected **negligible** incremental impacts of pile-driving noise and on- and offshore construction noise associated with the Proposed Action would not increase the impacts of noise beyond the impacts described under the No Action Alternative. Therefore, cumulative impacts on bats from noise associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be expected to be similar to the impacts under the No Action Alternative and would be expected to be **negligible**.

Presence of Structures: The various types of impacts on bats that could result from the presence of structures, such as migration disturbance and turbine strikes, are described in detail in Section A.8.4.1.1. Using the assumptions in Table A-4, there could be up to 2,021 new WTGs on the OCS where few currently exist, of which up to 100 would result from the proposed Project. The structures associated with the Proposed Action, and the consequential **negligible** impacts would remain at least until decommissioning of the proposed projects are complete. The cumulative impacts on bats from the presence of structures associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be expected to be **negligible** due to the expected limited use of the OCS by migrating tree bats. A majority (approximately 95 percent) of these impacts would occur as a result of structures associated with other future offshore wind development and not the Proposed Action, as the Proposed Action would account for about 4.9 percent (100 of 2,021) of the new structures on the OCS.

Land disturbance: Direct impacts associated with construction of onshore elements of the Proposed Action could occur if construction activities occur during the active season (generally April through October), and may result in injury or mortality of individuals, particularly juveniles who are unable to flush from a roost, if occupied by bats at the time of removal. Per the Vineyard Wind Biological Assessment prepared for the USFWS (BOEM 2019b), tree clearing activities would comply with the northern long-eared bat 4(d) rule and no tree clearing would occur when juveniles are unable to fly (June 1 through July 30), limiting the potential for direct injury or mortality resulting from the removal of occupied roost trees. There would be some potential for indirect impacts on bats as a result of the loss of potentially suitable roosting and/or foraging habitat. However, the Proposed Action would only remove 6.1 acres (0.02 km^2) of marginal quality habitat that is characterized by a cluttered understory. Further, a high-quality contiguous block of potentially suitable habitat within the Hyannis Ponds WMA is located as near as 0.25 mile (0.4 kilometer) from the site where habitat would be removed. BOEM anticipates that negligible direct impacts, if any, would occur due to adherence to USFWS northern long-eared bat conservation measures and that negligible indirect impacts would not result in individual fitness or population-level effects given the limited amount of habitat removal and the presence of high-quality habitat within the Hyannis Ponds WMA in the vicinity. Should the eastern Onshore Export Cable Route be chosen and construction occur before the Massachusetts Division of Fisheries and Wildlife clears the potential bike path, the Proposed Action would have **minor** impacts on bats, though local bat population would be expected to recover completely following tree clearing activities (Draft EIS Section 3.3.3.3). As such, the Proposed Action would not be expected to appreciably contribute to cumulative impacts on bats. The cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities would be expected to range from **negligible** to **minor** based on the sub-IPFs identified in Table A-12 as only a small amount of habitat loss, if any, would be expected.

Other considerations: For temporary impacts, including the effects of new cable emplacement and onshore construction, it is likely that a portion, possibly a majority, of such impacts from future activities would not overlap temporally or spatially with the

Proposed Action. However, some IPFs that may result in temporary impacts can also result in long-term to permanent impacts that would be expected to range from **negligible to minor**.

The cumulative impacts resulting from individual IPFs associated with the Proposed Action would range from **negligible** to **minor**. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would result in **minor** impacts on bats in the geographic analysis area. The main drivers for this impact rating are ongoing climate change and onshore habitat loss. The Proposed Action would contribute to the overall impact rating primarily through the permanent impacts due to the onshore habitat loss. Thus, the overall cumulative impacts on bats would likely qualify as **minor** because a notable and measurable impact is anticipated, but the resource would likely recover completely without any remedial or mitigating actions.

A.8.4.2.2 Cumulative Impacts of Alternatives B, C, D1 and D2

As discussed in Draft EIS Section 3.3.3.4, impacts of the construction and installation, operations and maintenance, non-routine activities, and decommissioning of Alternatives B and C on bats would be practically identical to those of the Proposed Action. Alternative B would narrow the PDE to include only the Covell's Beach landfall site and BOEM does not expect the change in landfall location to have any measurable effect on bats. BOEM also does not expect relocation of the six northern-most WTG locations under Alternative C to the southern portion of the WDA under Alternative C to significantly change the potential impacts because the total number of WTGs would remain the same, and the southern portion of the WDA does not include areas with higher densities of bats. Under Alternatives D1 and D2, the acreage of the WDA would increase compared to the Proposed Action. This could potentially lead to a slightly increased risk of individual migrating tree bats encountering the WDA. However, given the infrequent and limited use of the OCS by bats during spring and fall migration, BOEM does not anticipate impacts to be different than those described under the Proposed Action. While each of the alternatives would slightly change the potential direct and indirect impacts, the incremental impacts would not be expected to be materially different that those described under the Proposed Action—**negligible** to **minor**

The cumulative impacts of Alternatives B, C, D1, and D2 would be similar to those of the Proposed Action, as discussed in the preceding paragraphs, with individual IPFs leading to impacts ranging from **negligible** to **minor**. The overall cumulative impacts of Alternatives B, C, D1 and D2 when combined with past, present, and reasonably foreseeable activities on bats would be the same level as under the Proposed Action—**minor.** This impact rating is driven primarily by ongoing activities such as climate change as well as disturbance and habitat removal associated with onshore construction.

A.8.4.2.3 Cumulative Impacts of Alternative E

As discussed in Draft EIS Section 3.3.3.5 the direct and indirect impacts under Alternative E would be slightly less than those described under the Proposed Action. IPFs associated with the construction and installation of no more than 84 WTGs, including, pile-driving noise, temporary avoidance and displacement, would be reduced by approximately 16 percent compared to the maximum-case scenario under the Proposed Action, namely 100 WTGs. Should the Proposed Action involve the use of taller 14 MW, an even greater reduction in the number of WTGs would result. Although there is some correlative evidence from inland studies bat mortality increases with tower height (Barclay et al. 2007; Georgiakakis et al. 2012), fewer WTGs and more space between WTGs may allow greater opportunity for migrating tree bats (if present) to avoid WTGs. Overall, the expected negligible impacts on bats would not be materially different than those described under the Proposed Action. The use of taller 14-MW WTGs may have some potential to increase collision risk based on studies of terrestrial wind facilities (Barclay et al. 2007; Georgiakakis et al. 2012). However, given the expected limited use of the OCS by migrating tree bats, impacts would be expected to remain **negligible**.

While Alternative E may be slightly less impactful to bats than the Proposed Action, the cumulative impacts of Alternative E would be similar to the Proposed Action, as discussed in the preceding paragraphs, with individual IPFs leading to impacts ranging from **negligible** to **minor** impacts. The overall cumulative impacts of Alternative E, when combined with past, present, and reasonably foreseeable activities on bats would be the same level as under the Proposed Action–**minor**. This impact rating is driven primarily by ongoing activities such as climate change as well as disturbance and habitat removal associated with onshore construction.

A.8.4.2.4 Direct, Indirect, and Cumulative Impacts of Alternative F

Alternative F analyzes a vessel transit lane through the WDA, in which no surface occupancy would occur. BOEM assumes for the purposes of this analysis that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The WTGs that would have been located within the transit lane would not be eliminated from the Proposed Action; instead, the displaced WTGs would be shifted to locations south within the Lease Area. Under this alternative, BOEM is analyzing a 2- and 4-nautical-mile northwest/southeast vessel transit lane through the WDA combined with any action alternative; however this analysis focuses on the combination of Alternative F with either the Proposed Action or Alternative D2 layout. Therefore, the number of turbines would remain the same. Nevertheless, the increase in acreage would not be expected to increase the risk of migrating bats encountering an operating WTG because the number of turbines would remain the same. Alternative F would not change the potential direct and indirect impacts, and the expected **negligible** to **minor** impacts would not be expected to be materially different than those described under the Proposed Action because the total number of WTGs would remain the same, and the southern portion of the WDA does not include areas with higher densities of migrating bats. The direct and indirect impacts from the combination of the Alternative F with Alternative A or Alternative D2 are expected to be similar to combinations with the other alternatives. Consequently, these other potential combinations are not separately analyzed here.

In considering the cumulative impacts of Alternative F when combined with past, present, and reasonably foreseeable activities, BOEM assumes that the northern transit lane through the Vineyard Wind lease area (OCS-A 0501) would continue to the southeast through lease areas OCS-A 0520 and OCS-A 0521 and northwest through lease area OCS-A 0500. The cumulative impacts on bats resulting from individual IPFs associated with up to a 4-nautical mile transit lane transit lane through the proposed Project area under Alternative F, when combined with past, present, and reasonably foreseeable activities are not likely to be materially different from the Proposed Action and the individual IPFs would have negligible to minor impacts. The overall cumulative impacts of Alternative F on bats, when combined with past, present, and reasonably foreseeable activities, would not be expected to be materially different from the Proposed Action and are expected to be minor. This impact rating is driven primarily by ongoing activities such as climate change as well as disturbance and habitat removal associated with onshore construction.

BOEM has qualitatively evaluated the cumulative impacts of implementing all six RODA-recommended transit lanes, including the northern transit lane described for Alternative F, as well as five other transit lanes through the RI and MA Lease Areas. To the extent that additional transit lanes are implemented in the future outside of the WDA as part of RODA's suggestion, one or more reasonably foreseeable offshore wind projects may not be able to deliver the expected power generation capacity and therefore the demand for power generation capacity could not likely be met. As with Alternative F, the WTGs for other reasonably foreseeable offshore wind projects may need to be located further from shore, similar to the proposed Project. If all the proposed transit lanes were implemented the total number of WTGs expected would result a lower number of WTGs and would not be able to meet the demand. The effects could result in a similar impacts though on bats as discussed above.

A.8.4.2.5 Comparison of Alternatives

As summarized above and discussed in detail in Draft EIS Section 3.3.3.7, the anticipated direct and indirect negligible to minor impacts associated with the Proposed Action do not change substantially under Alternatives B through F. While the alternatives could slightly change the impacts on bats within the WDA, ultimately the same construction, operations, and decommissioning impacts would still occur. Alternatives B and C would be expected to result in negligible to minor direct and indirect impacts identical to those described under the Proposed Action with respect to bats. Alternatives D1, D2, and F have some potential to result in slightly more, but not materially different, negligible to minor impacts than those described under the Proposed Action. Alternative E may result in slightly fewer, but not materially different, negligible to minor impacts than those described under the Proposed Action.

Cumulative impacts under any action alternative would likely be very similar because the majority of the cumulative impacts of any alternative come from other future offshore wind development, which does not change between alternatives. However, the differences in incremental impacts between action alternatives would still apply when considered alongside the impacts of other ongoing and future activities. Therefore, cumulative impacts on bats would be slightly greater, but not materially different, under Alternatives D1, D2, and F, and slightly lower, but not materially different under Alternative E. The cumulative impacts resulting from individual IPFs associated with any alternative would range from negligible to minor.

In conclusion, the overall cumulative impacts on bats from any alternative, including the No Action Alternative, when combined with past, present, and reasonably foreseeable activities are expected to be minor. The main driver for this is a result of ongoing activities, disturbance and habitat removal associated with onshore construction, and climate change, which are expected to lead to noticeable temporary and permanent impacts across much of the geographic analysis area, of which a small portion is contributed by the Proposed Action.

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Table A-12: Summary of Activities and the Associated Impact-Producing Factors for Bats

Baseline Conditions: Bats are terrestrial species that spend almost their entire lives on or over land. On occasion, tree bats may potentially occur offshore during spring and fall migration and under very specific conditions like low wind and high temperatures.

All eight species of bats that occur in coastal Massachusetts, including the Northern long-eared bat (*Myotis septentrionalis*), may be present near the onshore facilities. Cave bat species are experiencing drastic declines due to White Nose Syndrome, a fungal bat disease in the United States resulting in mortality as high as 90 percent at some hibernation sites (Blehart et al. 2009; Gargas et al. 2009; Turner et al. 2011).

Use of the OCS by migrating tree bats is expected to be very low and limited to spring and fall migration periods.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded and would result in high-intensity, low-exposure level, long-term, but localized intermittent risk to bats in nearshore waters. Direct impacts are not expected to occur as recent research has shown that bats may be less sensitive to temporary threshold shifts than other terrestrial mammals (Simmons et al. 2016). Indirect impacts (i.e., displacement from potentially suitable habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior (Schaub et al. 2008). Construction activity would be temporary and highly localized.	Similar to ongoing activities, noise associated with pile driving activities would be limited to nearshore waters, and these high-intensity, but low-exposure risks would be not be expected to result in direct impacts. Some indirect impacts (i.e., displacement from potentially suitable foraging habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior (Schaub et al. 2008). Construction activity would be temporary and highly localized and no population-level effects would be expected.	Noise from pile driving would occur during installation of foundations for offshore structures at a frequency of 4 to 6 hours at a time over a 6- to 12-year period. Under a maximum-case scenario, construction would occur 24 hours per day. Construction activity would be short-term, temporary, and highly localized. Impacts on migrating tree bats are possible. No direct impacts would be expected to occur (Simmons et al. 2016). Pile driving activities have some potential to result in indirect impacts on individual migrating tree bats. However, these impacts are highly unlikely to occur, as little use of the OCS is expected, and only during spring and fall migration.	The Vineyard 1 Project has agreed to avoid nighttime pile driving. Therefore, there would be no contribution to this sub-IPF during construction, operations, and decommissioning, and non-measurable **negligible** impacts, if any, would be expected.	The Proposed Action is expected to result in non-measurable **negligible** impacts on bats through this sub-IPF. The impacts of ongoing activities and future non-offshore wind activities that occur in nearshore waters would be greater than the expected impacts from future offshore wind development, but would not be expected to result in individual fitness or population-level effects. No cumulative impacts would be expected to result through this sub-IPF from the incremental impacts of the Proposed Action or other future offshore wind development, given the limited expected use of the OCS by migrating bats. **Negligible** cumulative impacts associated with the Proposed Action and past, present, and reasonably foreseeable activities, if any, would be expected to be short-term, intermittent, and highly localized. Impacts would be primarily driven by construction activities in nearshore habitats.
Noise: Construction	Onshore construction occurs regularly for generic infrastructure projects in the bats geographic analysis area. There is a potential for displacement caused by equipment if construction occurs at night (Schaub et al. 2008). Any displacement would only be temporary. No individual or population level impacts would be expected. Some bats roosting in the vicinity of construction activities may be disturbed during construction, but would be expected to move to a different roost farther from construction noise. This would not be expected to result in any impacts as frequent roost switching is a common component of a bat's life history (Hann et al. 2017; Whitaker 1998).	Onshore construction is expected to continue at current trends. Some behavioral responses and avoidance of construction areas may occur (Schaub et al. 2008). However, no injury or mortality would be expected.	Onshore construction could take place to lay onshore transmission cable and in the rare occasion to make repairs. This activity would occur intermittently in the bats geographic analysis area. Some behavior responses and avoidance of construction areas may occur (Schaub et al. 2008) if construction occurs at night, but no injury or mortality would be expected. Some bats roosting in the vicinity of construction activities may be disturbed during construction, but would be expected to move to a different roost farther from construction noise. This would not be expected to result in any impacts as frequent roost switching is a common component of a bat's life history (Hann et al. 2017; Whitaker 1998).	All onshore construction activities are expected to occur during daylight hours, and as such, no displacement would occur. Bats roosting in the vicinity may be disturbed, but would be expected to move to an alternate roost. Non-measurable **negligible** impacts, if any, would expected (Hann et al. 2017; Whitaker 1998). While there is some potential for onshore construction to occur at night on an as-needed basis, impacts on foraging bats arising from temporary displacement in the vicinity of the construction activities would be expected to remain **negligible**.	The Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on bats through this sub-IPF. The impacts of ongoing and future non-offshore wind activities would be expected to result in highly localized, temporary, and short-term impacts only if construction occurs at night. Similarly, onshore construction associated with future offshore wind development would result in temporary and localized impacts only if construction occurs at night. **Negligible** cumulative impacts, if any, would be expected to result through this sub-IPF from the incremental impacts of the Proposed Action or other future offshore wind development, given the limited amount of habitat conversion that would be required.
Presence of structures: Migration disturbances	There are few structures scattered throughout the offshore bats geographic analysis area. There is an assortment of navigation and weather buoys and a handful of light towers (NOAA 2020). Migrating bats can easily fly around or over these sparsely distributed structures, and no migration disturbance would be expected. Bat use of offshore areas is very limited and generally restricted to spring and fall migration. Very few bats would be expected to encounter structures on the OCS and no population-level effects would be expected.	The infrequent installation of future new structures in the marine environment of the next 30 years is expected to continue. As described under Ongoing Activities, These structures would not be expected to cause disturbance to migrating tree bats in the marine environment.	Offshore wind-related activities will add up to 2,066 towers (turbines and ESPs) plus buoys. The structures will be patchily distributed and spaced 1 nautical mile (1.9 kilometers) apart allowing bats that are not flying above the WTGs to fly through individual projects without changing course or to make only minor course corrections to avoid operating WTGs. As stated in the Draft EIS, bat use of offshore areas is very limited and generally restricted to spring and fall migration. Very few bats would be expected to encounter structures on the OCS and no population level effects would be expected.	Up to 100 turbines could be installed plus 2 ESPs. Each could be spaced approximately 1 nautical mile (1.9 kilometers) apart allowing for most bats that are not flying above the towers to fly between individual towers or make minor course corrections. As stated in the Draft EIS, bat use of offshore areas is very limited and generally restricted to spring and fall migration. Very few bats would be expected to encounter structures associated with the Vineyard Wind 1 Project and no population-level effects would be expected. Given the limited anticipated use of the OCS, the Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on bats.	Given the limited anticipated use of the OCS, the Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on bats through this sub-IPF. Similarly, ongoing, future non-offshore wind, and future offshore wind activities would not be expected to appreciably contribute to this sub-IPF. **Negligible** cumulative impacts, if any, would be primarily driven by nearshore structures associated with ongoing activities and non-offshore wind development.
Presence of structures: Turbine strikes	There are few structures in the offshore bats geographic analysis area. There is an assortment of navigation and weather buoys plus a handful of light towers (NOAA 2020). Migrating tree bats can easily fly around or over these sparsely distributed structures, and no strikes would be expected.	The infrequent installation of future new structures in the marine environment of the next 30 years is expected to continue. As described under Ongoing Activities, these structures would not be expected to result in increased collision risk to migrating tree bats in the marine environment.	As stated in the Draft EIS, bat use of offshore areas is very limited and generally restricted to spring and fall migration. Bats are very rare in the offshore environment where future offshore wind development may occur. Some tree bats may pass through project areas during spring and fall migration, and some bats may use the structures (ESPs and turbine towers) to opportunistically roost. However, due to the rarity of bats in the offshore environment, the turbines being widely spaced, and the patchiness of projects, the likelihood of collisions is low.	Up to 100 turbines could be installed plus 2 ESPs. Each could be spaced approximately 1 nautical mile (1.9 kilometers) apart allowing for most bats that are not flying above the towers to fly between individual structures or make minor course corrections. However, due to the rarity of bats in the offshore environment, and the turbines being widely spaced, the likelihood of collisions is low. Given the limited anticipated use of the OCS, the Proposed Action is expected to result in in non-measurable **negligible** impacts.	Given the limited anticipated use of the OCS, the Proposed Action is expected to result in non-measurable **negligible** impacts through this sub-IPF. Impact from ongoing and future non-offshore wind activities would not be expected to result in impact on bats, as these stationary structures would be avoided by bats. Given the number of potential structures associated with the full buildout scenario, long-term impacts on migrating individuals may occur as a result of future offshore wind development. Population-level effects are unlikely due to the rarity of bats in the offshore environment. The incremental impacts of the Proposed Action are not expected to contribute to cumulative effects on bats. **Negligible** to **minor** cumulative

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
					effects, if any, would primarily be driven by future offshore wind development.
Land disturbance: onshore construction	Onshore construction activities are expected to continue at current trends. Potential direct effects on individuals may occur if construction activities include tree removal when bats are potentially present. Injury or mortality may occur if trees being removed are occupied by bats at the time of removal. Of particular sensitivity are juveniles that are unable to flush from the roost. While there is some potential for indirect impacts associated with habitat loss, no individual or population-level effects would be expected.	Future non-offshore wind development would continue to occur at the current rate. This development has the potential to result in habitat loss, but would not be expected to result in injury or mortality of individuals.	A small amount of infrequent construction impacts associated with onshore power infrastructure would be required over the next 6 to 12 years to tie future offshore wind energy projects to the electric grid. Typically, this would require only small amounts of habitat removal, if any. Indirect impacts associated with habitat loss or avoidance during construction may occur (Schaub et al. 2008), but no injury or mortality of individuals would be expected.	The Vineyard 1 Project would require temporary habitat alteration within an existing public utility ROW. Clearing, grading, and excavations would temporarily alter existing habitat, which is primarily grassland and small shrubs. Onshore construction associated with the Proposed Action is expected to result in impacts ranging from **negligible**, short-term, localized, non-biologically significant behavioral responses to **minor** impacts due to habitat loss and fragmentation (Draft EIS Section 3.3.3.3). The noise generated by construction activities, as well as the physical changes to the space, could render an area temporarily unsuitable for bats. Given the nature of the existing habitat, its abundance on the landscape, and the temporary nature of construction, the temporary impacts on bats species that frequent this forest edge/managed grassland ecosystem are not expected to be measurable.	Onshore construction associated with the Proposed Action is expected to result in impacts ranging from **negligible** to **minor** impacts due to habitat loss and fragmentation (Draft EIS Section 3.3.3.3). Onshore impacts from ongoing and non-offshore activities are expected to result in the same non-biologically significant behavior responses, but across a greater temporal and spatial scale. Future offshore wind, excluding the proposed Project, would also be expect to cause only non-biologically significant behavior responses. **Negligible** to **minor** cumulative impacts, equal to the sum of all of these impacts, are anticipated to result in no noticeable change to the condition of bats in the bats geographic analysis area.
Climate change: Warming and sea level rise, storm severity/frequency	Storms during breeding and roosting season can reduce productivity and increase mortality. Intensity of this impact is speculative.	No future activities were identified within the bats geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Section A.8.11 for the contribution of these activities to climate change.	This sub-IPF would contribute to cumulative impacts on bats through reduced productivity and potentially increased mortality. Because this sub-IPF is a global phenomenon, impacts on bats would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Section A.8.1 for the cumulative contribution of these activities to climate change.
Climate change: Ocean acidification; Warming and sea level rise, altered habitat/ecology; Warming and sea level rise, altered migration patterns; Warming and sea level rise, property/ infrastructure damage; Warming and sea level rise, protective measures (barriers, sea walls); Warming and sea level rise, storm severity/frequency, sediment erosion, deposition	These sub-IPFs would have no impacts on bats.	No future activities were identified within the bats geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Section A.8.1 for the contribution of these activities to climate change.	These sub-IPFs would not contribute to direct, indirect, or cumulative impacts on bats.
Climate change: Warming and sea level rise, increased disease frequency	Disease can weaken, lower reproductive output, and/or kill individuals. Some tropical diseases will move northward. Extent and intensity of this impact is highly speculative.	No future activities were identified within the bats geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Section A.8.1 for the contribution of these activities to climate change.	This IPF may contribute to changes in the frequency and distribution of bat diseases. Impacts are the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Section A.8.1 for the cumulative contribution of these activities to climate change.

EIS = Environmental Impact Statement; ESP = electrical service platform; IPF = impact-producing factors; NOAA = National Oceanic and Atmospheric Administration; OCS = outer continental shelf; ROW = right-of-way; WTG = wind turbine generator

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ATTACHMENT A: STATE BY STATE SUMMARY OF AWARDS AND MANDATES/GOALS

Maine: New England Aqua Ventus I is a 12 MW floating offshore wind pilot project in the state of Maine waters. The project is currently under review by the Maine Public Utilities Commission. http://maineaquaventus.com/index.php/the-project/

New Hampshire: New Hampshire does not currently have a renewable energy target for offshore wind.

Massachusetts: Massachusetts passed a law in August 2016 requiring utilities to procure 1,600 megawatts of offshore wind power by 2027. New legislation in August 2018 was passed that doubles the offshore wind target to 3,200 MW by 2035. Vineyard Wind was awarded a PPA for 800 MW and Mayflower Wind was awarded a PPA for 800 MW. The remaining 1,600 MW of the larger 3,200 MW goal by 2035 has not been scheduled and the timing in *Table 1* is an estimate. https://www.mass.gov/news/department-of-public-utilities-approves-offshore-wind-energy-contracts; https://www.mass.gov/news/project-selected-to-increase-offshore-wind-energy-in-the-commonwealth

Rhode Island: Revolution Wind's 700 MW project would deliver 400 MW to Rhode Island and 304 MW to Connecticut. In addition to the 400 MW from Revolution Wind the Block Island wind farm contributes 30 MW to Rhode Island's renewable energy goals for a total commitment of 430 MW. The state has a clean energy goal of 1,000 MW sourced from clean, renewable energy by 2020, but this 1,000 MW does not necessarily need to be generated solely from offshore wind energy sources. https://www.ri.gov/press/view/35210 https://www.ecori.org/renewable-energy/2019/6/2/revolution-wind-farm-power-contract-approved-but-without-extra-fund-for-national-grid

Connecticut announced on August 19, 2019 an RFP for up to the maximum authorized procurement level of 2,000 MW of offshore wind by December 31, 2030. On December 5, 2019 the State of Connecticut awarded 804 MW. This 804 MW is in addition to the 304 MW of offshore wind awarded to the joint RI/CT Revolution Wind project. This analysis assumes another award for up to the remaining 1,196 MW is possible by 2022.

https://www.ct.gov/deep/cwp/view.asp?A=5009&Q=610542

https://www.ct.gov/deep/cwp/view.asp?Q=610542&A=5009

New York: New York's original goal for offshore wind was 2,400 MW by 2030. The state increased the target for offshore wind to 9,000 MW by 2035. The full 9,000 MW target for offshore wind has no anticipated timeframe and therefore the full 9,000 MW is not considered in this analysis. There are three projects within New York that have been awarded contracts: Ørsted (880 MW), Equinor (816 MW), and LIPA has awarded 130 MW to South Fork. In 2020 New York is planning to award another procurement for at least 1,000 MW and up to 2,500 MW. The timing of the remaining capacity is not considered reasonably foreseeable or the current NEPA analysis. https://www.nyserda.ny.gov/All%20Programs/Programs/Offshore%20Wind/Offshore%20Wind%20in%20New%20York%20State%20Overview

http://documents.dps.ny.gov/public/MatterManagement/MatterFilingItem.aspx?FilingSeq=239315&MatterSeq=55709

New Jersey: The state passed legislation in May 2018 to increase New Jersey's offshore wind target from 1,100 MW to 3,500 MW by 2030. The New Jersey Board of Public Utilities (NJBPU) granted the state's first award for offshore wind to Ørsted's Ocean Wind 1,100 MW project. NJ-EDA anticipates an RFP for up to an additional 1,200 MW sometime in 2020 and the remaining 1,200 MW of the state's goal will be solicited in 2022. The Governor of New Jersey signed an executive order on November 19, 2019 that effectively raised New Jersey's offshore wind goal by 4,000 MW to a total of 7,500 MW. It is unclear how the additional desired capacity can be fulfilled with existing lease areas and technology and therefore is not included in this analysis. https://www.nj.gov/governor/news/news/562019/approved/20190621d.shtml https://www.njeda.com/pdfs/April-2019_New-Jersey-Offshore-Wind-Industry-Overv.aspx

https://www.nj.gov/dep/aqes/offshorewind.html

Delaware: Delaware does not currently have a renewable energy target for offshore wind. http://www.dnrec.delaware.gov/energy/Documents/Offshore%20Wind%20Working%20Group/Offshore%20Wind%20Working%20Group%20Report%20June%2029%202018.pdf

Maryland: The Maryland Public Services Commission awarded ORECs to Skipjack Offshore Energy, LLC (Deepwater Wind, LLC) and US Wind Inc. for 368 MW of total offshore wind capacity. Senate Bill 516 increased Maryland's renewable energy goal to 50% by 2030, including 1,200 MW of "Phase II" offshore wind. Per the law the Maryland Public Service Commission plan would open Phase II application periods in:

- 2020 to begin creating offshore wind renewable energy credits (ORECs) in 2026 or 2027;
- 2021 to begin creating ORECs in 2028 or 2029; and
- 2022 to begin creating ORECs no later than 2030. [1,200 MW split evenly (3 X 400)]

http://dnr.maryland.gov/pprp/Documents/RPS-Study-PPRAC-06122019.pdf

https://energy.maryland.gov/Pages/Info/renewable/offshorewind.aspx

http://mgaleg.maryland.gov/2019RS/fnotes/bil_0006/sb0516.pdf

Virginia: An Office of the Secretary of Commerce and Trade report recommends 2,000 MW of offshore wind by 2028. Virginia's SB 966 was signed into law in 2018 and affirms that up to 5,000 MW of nameplate wind and solar capacity is in the public interest by 2028. Executive Order #43 (2019) establishes an offshore wind goal of 2,500 MW in addition to Dominion

Energy's CVOW project (12 MW total). Dominion Energy has proposed a 2,640 MW project on its commercial lease. This analysis assumes Virginia will approve Dominion's proposed 2,640 MW offshore wind project to meet ~50% of the state's 5,000 MW solar/wind goal. In 2020, Virginia's General Assembly passed HB 1526 which requires at least 5.2 GW to be added by 2034.

https://www.governor.virginia.gov/media/governorvirginiagov/secretary-of-commerce-and-trade/2018-Virginia-Energy-Plan.pdf

https://www.governor.virginia.gov/media/governorvirginiagov/executive-actions/EO-43-Expanding-Access-to-Clean-Energy-and-Growing-the-Clean-Energy-Jobs-of-the-Future.pdf

https://news.dominionenergy.com/2020-01-07-Dominion-Energy-Selects-Siemens-Gamesa-as-Preferred-Turbine-Supplier-for-Largest-Offshore-Wind-Power-Project-in-United-States

https://openstates.org/va/bills/2020/HB1526/

North Carolina: The governor has issued clean energy and wind energy executive orders, but the state has not passed enacting legislation. NC Clean Energy Executive Order: https://governor.nc.gov/documents/executive-order-no-80-north-carolinas-commitment-address-climate-change-and-transition. If developed, the North Carolina Kitty Hawk lease would tie into the Virginia PJM grid. The lessee (Avangrid) has submitted interconnection applications to PJM which is a preliminary first step toward development. https://www.boem.gov/Kitty-Hawk-Offshore-Wind-stakeholder-webinar/.

South Carolina: The State of South Carolina does not currently have any published targets or goals for offshore wind energy. See http://www.energy.sc.gov/renewable.

APPENDIX B

Tables and Figures

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APPENDIX B. TABLES AND FIGURES

B.1. TABLES

Note for all impact-producing factor tables in this appendix: As described throughout the SEIS, the reasonably foreseeable offshore wind elements assessed in the cumulative scenario varies by resource and is dependent upon the resource-specific geographic analysis areas defined in Table A-1 and shown on Figures A.7-1 through A.7-16 in Appendix A. Appendix A describes the assumptions used for the cumulative offshore wind analysis.

Table 1.2-1. Atlantic Offshore Wind Commitments by State (in megawatts)

State [a]	<2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030+	Total MW
Maine		12 (AN)											**12**
New Hampshire													**0**
Massachusetts	1,600 (AW)				800 (P)			800 (P)					**3,200**
Rhode Island	430 (AW)												**430**
Connecticut	1,108 (AW)			1,196 (AN)									**2,304**
New York	1,826 (AW)	2,500 (AN)			1,200 [b]		1,200 [b]		1,200 [b]		1,074 [b]		**9,000**
New Jersey	1,100 (AW)	1,200 (AN)		1,200 (AN)		1,200 [c]		1,400 [c]		1,400 [c]			**7,500**
Delaware													**0**
Maryland	368 (AW)	400 (AN)	400 (AN)	400 (AN)									**1,568** [d]
Virginia	12 (AW)			880 (P)	880 (P)	880 (P)						2,600 [c]	**5,252**
North Carolina													**0**
South Carolina													**0**
Total	**6,444**	**4,112**	**400**	**3,676**	**2,880**	**880**	**1,200**	**800**	**1,200**	**0**	**1,074**	**4,000**	**29,266**

AN = Announced; AW = Awarded; MW = megawatt; P = Planned but currently unscheduled.

[a] See Attachment A in Appendix A for a state-by-state summary of authorizing legislation and caveats.

[b] Beyond the pending procurement (January 2020 petition to State of New York Public Service Commission for up to 2,500 MW), New York is not likely to announce additional procurements without additional leasing in the New York Bight. Therefore, offshore wind development beyond the announced and awarded procurements is not considered reasonably foreseeable at this time.

[c] Similar to table note b, New Jersey and Virginia are not likely to announce additional procurements without additional leasing. Therefore, offshore wind development beyond the announced and awarded procurements is not considered reasonably foreseeable at this time.

[d] In Maryland, the developer plans to use larger turbines and have a higher capacity than it has Offshore Wind Renewable Energy Credits approved. Excess electricity may be sold into the open market without subsidies.

The reasonably foreseeable state offshore wind commitments total 17,992 MW: AW (Awarded) = 6,444 MW; AN (Announced) = 7,308 MW; P (Planned, but currently unscheduled) = 4,240 MW.

Table 1.2-2. Atlantic Offshore Wind Projects

Leased but Project Not Yet Announced	Announced but COP Not Submitted	COP Submitted but Not Approved	Approved	Notes
	Liberty Wind (Massachusetts)			Up to 1,200 MW in bids total planned capacity; *Currently No Offtake*
		Proposed Project (Vineyard Wind, Massachusetts)		COP proposes 800 MW; Massachusetts PPA
	Vineyard Wind 2 (Massachusetts)			Up to 1,668 MW in two phases total planned capacity; Connecticut PPA for 804 MW
		Bay State (Massachusetts)		COP proposed 800 MW; *Currently No Offtake*
	Mayflower Wind (Massachusetts)			Up to 804 MW in bids total planned capacity; *Currently No Offtake*
Equinor (Massachusetts)				*Currently No Offtake*
	Sunrise Wind (Massachusetts/ Rhode Island)			New York PPA for 880 MW
		Revolution Wind (Massachusetts/ Rhode Island)		Rhode Island/Connecticut PPAs totaling 704 MW
		South Fork (Massachusetts/ Rhode Island)		COP proposes 130 to 180 MW; New York PPA for 90 MW
		Empire Wind (New York)		COP proposes 2,400 MW; New York PPA for 816 MW
Atlantic Shores (New Jersey)				Developer stated capacity of lease is 2,500 MW; *Currently No Offtake*
		Ocean Wind (New Jersey)		1,100 MW; New Jersey PPA
		Skipjack (Delaware)		120 MW; Maryland OREC
	U.S. Wind (Maryland)			248 to 250 MW; Maryland OREC
			CVOW (Virginia)	12 MW; Research project
	Virginia Commercial (Virginia)			Developer stated capacity of lease 2,640 MW; *Currently No Offtake*
Avangrid (NC)				*Currently No Offtake*
		Subtotal up to 5,414 MW		
	Subtotal up to 13,520 MW			

COP = Construction and Operation Plan; CVOW = Coastal Virginia Offshore Wind; MW = megawatts; OREC = Offshore Wind Renewable Energy Credit; PPA = Power Purchase Agreement.
All projects listed in this table are included within the cumulative analysis.

Table 1.2-3. Primary Impact-Producing Factors Addressed in This Analysis

Impact-Producing Factors	Description
Accidental releases • Fuel/fluids/hazmat • Invasive species • Trash and debris	Refers to unanticipated release or spills of a fluid or other substance that can affect the quality of a resource. Could include invasive species from ballast water. Can occur from a stationary source (e.g., renewable energy structures), or a mobile source (e.g., vessels). Accidental releases are distinct from discharges (see below) that are authorized and typically controlled through permit systems.
Air emissions • Construction and decommissioning • O&M • Power generation emissions reductions	Refers to the release of gaseous or particulate pollutants into the atmosphere from stationary sources, vessels, vehicles, or aircrafts, which can affect air quality and associated resources. Can occur both onshore and offshore and during construction, operations and maintenance, and decommissioning.
Anchoring	Refers to anchoring of a vessel or a structure to the sea bottom, which can cause alterations to the seafloor from the anchor or anchor chain sweep. Does not refer to designated anchorage areas for marine transportation, all of which are far from wind energy areas.
Beach restoration	Refers to renourishment and restoration activities at coastal beaches involving the replacement of sand lost through erosion or drift.
Climate Change • Ocean acidification • Warming and sea level rise, storm severity/frequency • Warming and sea level rise, altered habitat/ecology • Warming and sea level rise, altered migration patterns • Warming and sea level rise, disease frequency • Warming and sea level rise, property/infrastructure damage • Warming and sea level rise, protective measures (barriers, seawalls) • Warming and sea level rise, storm severity, frequency, sediment erosion, deposition • Warming and sea level rise, storm severity/frequency, property and infrastructure damage	Warming and sea level rise refers to the effects associated with climate change, storm severity/frequency, and sea level rise. Ocean acidification refers to the effects associated with the decreasing pH of seawater caused by rising levels of atmospheric CO^2.
Discharges	Refers to routine permitted operational effluent discharges to receiving waters. Generally restricted to uncontaminated or properly treated effluents.
EMF	Refers to active power transmission cables and other sources that can produce electromagnetic fields emanating from the operating source.
Energy generation/security	Refers to the generation of electricity and its provision of reliable energy sources as compared with other energy sources.
Gear utilization • Dredging	Refers to entanglement and benthic disruptions that may affect biota. Primarily associated with commercial and recreational fishing activities, but also may be associated with marine minerals extraction and military uses. The sub-IPFs reference gear types that may lead to the entanglement and benthic disruptions.
Ingestion • Plastics and debris	Refers to the ingestion by biota of non-natural materials.
Land disturbance • Erosion and sedimentation • Onshore construction • Onshore, land use changes	Refers to land disturbances, including those associated with residential, commercial, or industrial development.
Light • Structures • Vessels	Refers to the presence of light from artificial sources onshore, offshore, above the water, or underwater.
New cable emplacement/maintenance	Refers to disturbances associated with installing new offshore submarine cables.
Noise • Aircraft • Cable laying/trenching • Drilling • G&G • O&M • Pile driving • Turbines • Vessels	Refers to noise from various sources. Commonly associated with construction activities (onshore and offshore), G&G surveys, naval testing and training, and vessel traffic. May be impulsive (e.g., pile driving) or may be broad spectrum and continuous (e.g., noise from marine transportation vessels). There is also noise from natural sources (e.g., wind and wave action, and noises produced by animals).

Impact-Producing Factors	Description
Port utilization • Expansion • Maintenance/dredging	Refers to changes in port usage and maintenance. Includes activities related to port expansion, reconfiguration, and other changes to accommodate increased vessel activity, larger vessels, and new uses of dockside facilities.
Presence of structures • Allisions • Behavioral disruptions – breeding and migration • Displacement into higher risk areas • Disturbed hydraulics and hydrologic regimes • Entanglement, gear loss/damage • Fish aggregation • Habitat conversion • Migration disturbances • Navigation hazard • Onshore, space use conflicts • Offshore, space use conflicts • Transmission cable infrastructure • Turbine strikes • Viewshed	Refers to impacts associated with onshore or offshore structures other than those related to construction, installation, and decommissioning.
Regulated fishing effort	Refers to limits or controls on commercial and recreational fishing activities.
Seabed profile alterations	Refers to modification of the seabed associated with marine minerals (sand and gravel) extraction, not maintenance dredging of navigation channels.
Sediment deposition and burial	Refers to the deposition of dredged materials at approved offshore dredge spoil disposal sites or to discharges of drilling muds and drill cuttings from oil and gas development or geotechnical survey activities. Can also be associated with construction-related activities that increase the amount of suspended sediment (e.g., setting anchors or submarine cable emplacement).
Traffic • Aircraft • Onshore • Vessel strikes, sea turtles and marine mammals • Vessels • Vessel collisions	Refers to marine vessel and onshore vehicle congestion, including collisions, allisions, and vessel strikes of sea turtles and marine mammals.

CO^2 = carbon dioxide; EMF = Electromagnetic field; G&G = Geological and Geophysical; IPF = impact-producing factor; hazmat = hazardous materials; O&M = Operations and Maintenance

Table 3-1: Definitions of Potential Adverse Impact Levels

Impact Level	Biological, Archaeological, and other Physical Resources	Socioeconomic Resources
Negligible	Either no effect or no measurable impacts.	Either no effect or no measurable impacts.
Minor	Most adverse impacts on the affected resource(s), including: • Local ecosystem health • The extent and quality of local habitat for both special-status species and species common to the proposed Project area • The richness or abundance of local species common to the proposed Project area • Air or water quality • Archaeological resource(s) could be avoided; OR impacts that could occur would be small and the affected resource would recover completely without remedial or mitigating action.	• Most adverse impacts on the affected activity or community could be avoided; • Impacts would not disrupt the normal or routine functions of the affected activity or community; OR • The affected activity or community is expected to return to a condition with no measurable effects without remedial or mitigating action.
Moderate	A notable and measurable adverse impact on the affected resource(s), including: • Local ecosystem health • The extent and quality of local habitat for both special-status species and species common to the proposed Project area • The richness or abundance of local species common to the proposed Project area	• Mitigation would reduce adverse impacts substantially during the life of the proposed Project, including decommissioning; • The affected activity or community would have to adjust somewhat to account for disruptions due to notable and measurable adverse impacts of the project; OR • Once the impacting agent is gone, the affected activity or community is expected to return to a condition with no

Impact Level	Biological, Archaeological, and other Physical Resources	Socioeconomic Resources
	• Air or water quality • Archaeological resource(s) could occur, some of which may be irreversible; OR the affected resource would recover completely when remedial or mitigating action is taken.	measurable effects, when remedial or mitigating action is taken.
Major	A regional or population-level impact on the affected resource(s), including: • Ecosystem health • The extent and quality of habitat for both special-status species and species common to the proposed Project area • Species common to the proposed Project area • Air or water quality • Archaeological resource(s) could occur; AND the affected resource would not fully recover, even after the impacting agent is gone and remedial or mitigating action is taken.	• Mitigation would reduce adverse impacts somewhat during the life of the proposed Project, including decommissioning; • The affected activity or community would have to adjust to significant disruptions due to large local or notable regional adverse impacts of the project; AND • The affected activity or community may retain measurable effects indefinitely, even after the impacting agent is gone and remedial action is taken.

Table 3-2: Definitions of Potential Beneficial Impact Levels

Benefit Level	Biological, Archaeological, and other Physical Resources	Socioeconomic Resources
Negligible	Either no effect or no measurable impacts.	Either no effect or no measurable impacts.
Minor	A small and measurable: • Improvement in ecosystem health; • Increase in the extent and quality of habitat for both special-status species and species common to the proposed Project area; • Increase in populations of species common to the proposed Project area; • Improvement in air or water quality; OR • Limited aerial extent or short-term temporal duration of improved protection of archaeological resource(s).	A small and measurable: • Improvement in human health; • Benefits for employment; • Improvement to infrastructure/facilities and community services; • Economic improvement; OR • Benefit for tourism or cultural resources.
Moderate	A notable and measurable: • Improvement in local ecosystem health; • Increase in the extent and quality of local habitat for both special-status species and species common to the proposed Project area; • Increase in individuals or populations of species common to the proposed Project area; • Improvement in air or water quality; OR • Extensive/complete aerial extent, or long-term temporal duration of, improved protection of archaeological resource(s).	A notable and measurable: • Improvement in human health; • Benefits for employment; • Improvements to facilities/infrastructure and community services; • Economic improvement; OR • Benefit for tourism or cultural resources.
Major	A regional or population-level: • Improvement in the health of ecosystems; • Increase in the extent and quality of habitat for both special status and commonly occurring species; • Improvement in air or water quality; OR • Permanent protection of archaeological resource(s).	A large local, or notable regional: • Improvement in human health; • Benefits for employment; • Improvements to facilities and community services; • Economic improvement; OR • Benefit to tourism or cultural resources.

Table 3-3: Maximum-case Scenario for WTGs for Each Resource

Resource	WTGs in Maximum-case Scenario	Rationale
Terrestrial and Coastal Fauna	N/A	The number of offshore WTGs would not alter onshore impacts.
Coastal Habitats	N/A	The number of offshore WTGs would not alter the coastal habitat impacts.
Benthic Resources	100	Due to the potential total amount of surface disturbance.
Finfish, Invertebrates and Essential Fish Habitat	100	Due to the potential loss of area and change in habitat.
Maine Mammals	100	Due to the potential for noise and loss of area.
Sea Turtles	100	Due to the potential for noise and loss of area.
Demographics, Employment, and Economics	57	Due to the potential for smaller beneficial economic impacts from reduced number of WTGs manufactured, fabricated, and installed, and increased visual impacts for taller WTGs.
Environmental Justice	57	Due to the potential for the taller WTGs to be more visible from more coastal locations.
	100	Due to the potential for impacts on vessel traffic for commercial and recreational fishing and boating and related industries that provide employment for low-income workers.
Cultural Resources	57	Due to the potential for the taller WTGs to be more visible within the area of potential effect.
Recreation and Tourism	57	Due to the potential for the taller WTGs to be more visible from more coastal locations.
	100	Due to the potential for increased navigational complexity associated with recreational fishing.
Commercial Fisheries and For-Hire Commercial Fishing	100	Due to the potential for increased navigational complexity, space use conflicts, and loss of area.
Land Use and Coastal Infrastructure	N/A	The number of offshore WTGs would not alter impacts on land use and coastal infrastructure.
Navigation and Vessel Traffic	100	Due to the potential for increased navigational complexity.
Other Uses	57	Due to the potential for the taller WTGs to create potential hazards.
Air Quality	100	Due to the potential total number of trips required for construction.
Water Quality	100	Due to the potential total amount of sediment disturbance and spills.
Birds	100	Due to the potential for collisions and more air space being occupied.
Bats	100	Due to the potential for collisions and more air space being occupied.

N/A = not applicable; WTGs = wind turbine generators

Table 3.1-1: Summary of Activities and the Associated Impact-Producing Factors for Terrestrial and Coastal Fauna

BOEM expects the faunal resources in this area to have small home ranges and therefore impacts outside their home ranges are unlikely to affect them.

The geographic analysis area for terrestrial and coastal fauna is located within the Long Island-Cape Cod Coastal Lowland Major Land Resource Area. Much of this area exhibits sandy soils, mixed hardwood-softwood forests, and scrublands subject to periodic fires.

Pine-oak forest is one of the most common habitat types on Cape Cod. This habitat also predominates in the 365-acre (1.5-km^2) Hyannis Ponds WMA, which is managed for wildlife habitat and other non-consumptive uses. Therefore, terrestrial fauna have access to high quality, unfragmented habitat. Much of the other habitat in the geographic analysis area is already fragmented and/or developed for human uses, including roads, utility ROW, an airport, and commercial and light industrial operations. 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 fauna, has been degraded.

Of the approximately 48,000 acres (194.2 km^2) of wetlands in Massachusetts, approximately 1,250 acres (5.1 km^2) were changed to other land cover types between 1991 and 2005 (Commonwealth of Massachusetts 2018). The geographic analysis area is in a densely developed part of the state with several nearby wetlands. In the area within approximately 1.5 miles from the geographic analysis area, the Massachusetts Department of Environmental Protection has identified 1.4 acres (5,665.6 m^2) of wetland loss from 2001 to 2009, the most recent year for which wetland maps are available (MassDEP 2016).

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Land disturbance: Erosion and sedimentation	Periodic ground-disturbing activities contribute to elevated levels of erosion and sedimentation, but usually not to a degree that affects terrestrial and coastal fauna, assuming that industry standard BMPs are implemented.	No future activities were identified within the geographic analysis area other than ongoing activities.	Although BOEM is not aware of any future offshore wind activities other than the Proposed Action that would overlap the geographic analysis area for terrestrial and coastal fauna, it is conceivable that a future project could cross the geographic analysis area or even be collocated (partly or completely) within the same terrestrial ROW corridor that the Proposed Action would use. In such a case, the impacts of those future offshore wind activities on terrestrial and coastal fauna would be similar to the direct and indirect impacts of the Proposed Action alone.	During onshore construction, the Proposed Action would have the potential to deliver sediment into nearby wetlands and/or a stream and thus alter those habitats and potentially impact fauna that rely on them. With BMPs and the proposed avoidance and minimization measures, BOEM anticipates the Proposed Action would cause a **negligible** impact on terrestrial and coastal fauna through erosion and sedimentation.	The Proposed Action would lead to a **negligible** impact on terrestrial and coastal fauna through erosion and sedimentation. Ongoing activities typically do not cause impacts on terrestrial and coastal fauna through this sub-IPF. Other offshore wind activities within the geographic analysis area may cause impacts similar to those of the Proposed Action. Cumulative impacts on terrestrial and coastal fauna through erosion and sedimentation associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are anticipated to be **negligible**.
Land disturbance: Onshore construction	Periodic clearing of shrubs and tree saplings along existing utility ROWs causes disturbance and temporary displacement of mobile species and may cause direct injury or mortality of less-mobile species, resulting in short-term impacts that are less than noticeable. Continual development of residential, commercial, industrial, solar, transmission, gas pipeline, onshore wind turbine, and cell tower projects also causes disturbance, displacement, and potential injury and/or mortality of fauna, resulting in small temporary impacts.	Development at a recently graded, bare 8.3-acre (33,585 m^2) site approximately 240 feet (73 meters) from the proposed eastern onshore cable route may cause disturbance and displacement of fauna, resulting in temporary impacts during construction that are less than noticeable.	See above.	During onshore construction, the Proposed Action would cause disturbance, temporary displacement, and potential injury and/or mortality of fauna on up to 15.8 acres (63,940 m^2), resulting in **minor** temporary impacts. During operations and maintenance, similar impacts could occur in parts of this area where maintenance activities are needed.	The Proposed Action would lead to **minor** impacts of disturbance, displacement, and potential injury and/or mortality on terrestrial and coastal fauna as a result of onshore construction. Ongoing activities periodically cause similar **minor** impacts on terrestrial and coastal fauna. Other offshore wind activities within the geographic analysis area may cause impacts similar to those of the Proposed Action. Cumulative impacts (disturbance, displacement, injury, mortality) on terrestrial and coastal fauna through onshore construction associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are anticipated to be **minor**. Repeated construction in any particular area would be expected to have less impact (e.g., displacement, mortality, habitat loss) on terrestrial and coastal fauna than construction in an equivalent area of undisturbed habitat.
Land disturbance: Onshore, land use changes	Periodically, undeveloped parcels are cleared and developed for human uses, permanently changing the condition of those parcels as habitat for terrestrial fauna. Continual development of residential, commercial, industrial, solar, transmission, gas pipeline, onshore wind turbine, transportation infrastructure, sewer infrastructure, and cell tower projects could permanently convert various areas.	Creation of a proposed new 1.3-mile (2.1-kilometer) bike path extension through the Hyannis Ponds WMA could permanently convert 6.3 acres (25,495 m^2) of forest.	See above.	In the course of construction, the Proposed Action would convert up to approximately 12.4 acres (50,181 m^2) of forest to developed land and managed grassland, resulting in a **minor** to **moderate** permanent impact of habitat loss.	The Proposed Action would lead to a **minor** to **moderate** permanent impact on terrestrial and coastal fauna through converting up to approximately 12.4 acres (50,181 m^2) of forest to developed land and managed grassland. Ongoing activities periodically add to permanent impacts on terrestrial and coastal fauna through land use changes. Other offshore wind activities within the geographic analysis area may cause impacts similar to those of the Proposed Action. Cumulative impacts on terrestrial and coastal fauna through land use changes associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to include a gradually increasing amount of habitat loss, resulting in **minor** to **moderate** impacts on terrestrial and coastal fauna. Collocation of multiple uses in any particular developed area would be expected to have less impact on terrestrial and coastal fauna than developing an equivalent area of undisturbed habitat.
Climate change: Warming and sea level rise, altered habitat/ecology	Climate change, influenced in part by greenhouse gas emissions, is altering the seasonal timing and patterns of species distributions and ecological relationships, likely causing permanent changes of unknown intensity gradually over the next 30 years.	No future activities were identified within the geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of future offshore wind activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of the Proposed Action to climate change.	This sub-IPF is altering the seasonal timing and patterns of species distributions and ecological relationships of terrestrial and coastal fauna. The intensity of impacts resulting from climate change are uncertain but are anticipated to qualify as **minor** to **moderate**. Because this sub-IPF is a global phenomenon, impacts on terrestrial and coastal fauna though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change.

BMPs = best management practices; BOEM = Bureau of Ocean Energy Management; IPF = impact-producing factors; km^2 = square kilometers; m^2 = square meter; ROW = right-of-way; WMA = wildlife management area

Table 3.2-1: Summary of Activities and the Associated Impact-Producing Factors for Coastal Habitats

Baseline Conditions: Shorelines in the geographic analysis area for coastal habitats are primarily sand beaches, rocky shores, and armored shorelines. Landward of the intertidal zone, coastal habitat is mostly a mixture of sandy beaches, rocks, and developed spaces. Other coastal habitats on land in the geographic analysis area include sand dunes, salt ponds, salt marshes, and scattered maritime forest.

Submerged habitats out to 3 nautical miles from land are primarily sandy but include some areas of shell aggregate, gravel-cobble beds, biogenic structures, sand waves, sponge beds, and isolated boulders. Hard bottom typically consists of a combination of coarse deposits such as gravel, cobble, and boulders in a sand matrix. Certain hard-bottom areas also include piles of exposed boulders. At least 10 bedrock outcrops are in the analysis area, although none is present in the proposed Project area or OECC. Massachusetts defined special, sensitive, and unique (SSU) habitats to include eelgrass beds, hard and/or complex bottom, and North Atlantic right whale (*Eubalaena glacialis*) core habitat.

Conditions of coastal habitats in the geographic analysis area are mostly relatively stable. There is often marked patchiness and sample-to-sample variability in habitats and fauna across space and time. Sand waves are locally abundant and are mobile over the course of days to years. Eelgrass habitats in this region are in decline, with a loss of over 20 percent from 1994 to 2011 (Costello and Kenworthy 2011). Sandy beaches in these areas are subject to erosion and are vulnerable to the effects of projected climate change and relative sea level rise (Roberts et al. 2015). Coastal habitats on land in the geographic analysis area are partially developed with groins, jetties, seawalls, residences, and light commercial establishments, especially in the proposed Project area, and this development is likely to continue.

Commercial fishing using bottom trawls and dredge fishing methods disturbs swaths of seafloor habitat. When this intersects SSU habitats, long-term disruptions can result. Their impacts are similar in nature but much greater in extent and severity than those caused by other bottom-directed IPFs such as pipeline trenching or submarine cable emplacement that create a relatively narrow trench and backfill in the same operation. Dredging for navigation, marine minerals extraction, and/or military uses disturbs swaths of seafloor habitat. When this intersects SSU habitats, long-term disruptions can result. Their impacts are similar in nature but much greater in extent and severity than those caused by other bottom-directed IPFs such as pipeline trenching or submarine cable emplacement that create a relatively narrow trench and backfill in the same operation.

Commercial and recreational regulations for finfish and shellfish implemented and enforced by either Massachusetts or the towns of Barnstable and Yarmouth, depending on whether the fishery is within state or town waters, affect coastal habitats by modifying the nature, distribution, and intensity of fishing-related impacts.

Coastal habitats are also vulnerable to non-point-source nutrient pollution, much of which is due to discharges from septic systems onshore. These increases can affect coastal wetlands and other nearshore coastal habitats. Nutrient overloading in estuaries and coastal waters goes back several decades (Cape Cod Commission 2013a). Discharges from vessels are not permitted within 3 nautical miles of shore.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/ hazmat	See Appendix A Section A.8.2 for a discussion of ongoing accidental releases. Accidental releases of fuel/fluids/hazmat have the potential to cause habitat contamination and harm to the species that build biogenic coastal habitats (e.g., eelgrass, oysters, mussels, slipper limpets, salt marsh cordgrass) from releases and/or cleanup activities. Only a portion of the ongoing releases contact coastal habitats in the geographic analysis area. Impacts are small, localized, and temporary.	See Appendix A Section A.8.2 for a discussion of accidental releases.	Potential but unlikely impacts include habitat contamination and harm to the species that build biogenic coastal habitats (e.g., eelgrass, oysters, mussels, slipper limpets, salt marsh cordgrass) from spills and/or cleanup activities. See Appendix A Section A.8.2 for quantification. The greatest risk to coastal habitats is related to transportation of crews and equipment during construction and operations, as well as accidental releases from any nearshore equipment associated with transmission cables. Accidental releases from offshore structures would likely not reach coastal habitats. Onshore, the use of heavy equipment could result in potential spills during use or refueling activities. Onshore construction and installation activities and associated equipment would involve fuel, lubricating oil, and hydraulic oil. Accidental releases may occur primarily during construction, but also during operations and decommissioning. Accidental releases would increase under an expanded cumulative scenario; however, there does not appear to be evidence that the volumes and spatial and temporal extents would have any cumulative impact.	See Table A-8 in Appendix A for a quantitative analysis of these risks. The Proposed Action would increase the risk of releases, primarily during construction, but also during operations and decommissioning. Impacts, if any, on coastal habitats contamination would be localized, temporary, and **minor**. An accidental release from a Vineyard Wind offshore structure or offshore vessel would be unlikely to extend far enough to reach a coastal habitat.	See Table A-8 in Appendix A for a quantitative analysis of these risks. The impacts on coastal habitats from this sub-IPF under the Proposed Action would include an increased potential for a release that would have localized, temporary, and **minor** impacts of habitat contamination. The impacts from ongoing activities and future non-offshore wind activities stem from the increased potential for releases over the next 30 years due to increasing vessel traffic and ongoing releases, which are frequent/chronic. Future offshore wind activities would contribute to an increased risk of releases and impacts on coastal habitats. The contribution from future offshore wind and the Proposed Action would be a low percentage of the overall risk from ongoing activities. Cumulatively, the impacts to coastal habitats (contamination) from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be localized, temporary, and **minor,** due to the likely limited extent and duration of a release, described in detail in the Draft EIS Section 3.2.2.3, Impacts of Alternative A (Proposed Action) on Water Quality.
Accidental releases: Trash and debris	Ongoing releases of trash and debris occur from onshore sources, fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying. As population and vessel traffic increase, accidental releases of trash and debris may increase. Such materials may be obvious when they come to rest on shorelines; however, there does not appear to be evidence that the volumes and extents would have any detectable impact on coastal habitats.	No future activities were identified within the geographic analysis area for coastal habitats other than ongoing activities.	Trash and debris may be released by vessels during construction, operations, and decommissioning. BOEM assumes that all vessels will comply with laws and regulations to minimize releases. In the event of a release, it would be an accidental, small event in the vicinity of Project areas. Nearshore project activities, such as transmission cable installation or transportation of equipment and personnel from ports would have a higher likelihood of releases. Accidental releases of trash and debris may occur primarily during construction, but also during operations and decommissioning; however, there does not appear to be evidence that the volumes and extents would have any detectable impact on coastal habitats.	Trash and debris may be released by vessels during construction, operations, and decommissioning. BOEM assumes that all vessels will comply with laws and regulations to minimize releases. In the event of a release, it would be an accidental, small event in the vicinity of Project areas. Nearshore project activities such as transmission cable installation or transportation of equipment and personnel from ports would have a higher likelihood of impacts. Accidental releases of trash and debris may occur primarily during construction, but also during operations and decommissioning; however, there does not appear to be evidence that the volumes and extents would have any detectable impact on coastal habitats. Therefore, the Proposed Action would have no impact on coastal habitats through this sub-IPF.	Accidental releases of trash and debris would have no impact; they are not likely to have any detectable impact on coastal habitats. Cumulative accidental trash and debris releases associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would occur but would likely have no impact, given that there does not appear to be evidence that the likely volumes and extents would have any detectable cumulative impact on coastal habitats.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Anchoring	Vessel anchoring related to ongoing military, survey, commercial, and recreational activities will continue to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. These impacts include increased turbidity levels and potential for direct contact to cause physical damage to coastal habitats. All impacts are localized; turbidity is short-term and temporary; physical damage can be permanent if it occurs in eelgrass beds or hard bottom.	No future activities were identified within the geographic analysis area for coastal habitats other than ongoing activities.	If future offshore wind activities overlap with the geographic analysis area, there will be increased anchoring during survey activities and during the construction and installation of offshore export cables. There may also be anchoring in the analysis area during operations and decommissioning. These impacts would include increased turbidity levels and potential for direct contact causing physical damage to coastal habitats. All impacts would be localized; turbidity would be short-term and temporary; physical damage could be permanent if it occurs in eelgrass beds or hard bottom.	The Proposed Action is estimated to have anchoring disturb between 3.7 and 4.4 acres (14,973 and 17,806 m^2) (Epsilon 2018b), some of which would occur outside the geographic analysis area. This would occur primarily during construction, but also during operations and decommissioning and would include increased turbidity and the potential for direct contact to damage coastal habitats. The proposed Project would not anchor in eelgrass. Anchoring disturbances would recover naturally, unless they occur directly on a boulder pile, which is unlikely. The overall impact of anchoring on coastal habitats would be **minor** to **moderate**.	Anchoring associated with the Proposed Action would disturb up to 4.4 acres (17,806 m^2, some of which would occur outside the geographic analysis area, resulting in temporary to short-term **minor** to **moderate** impacts on coastal habitats. Ongoing and future non-offshore wind activities would cause a series of temporary localized impacts. Offshore wind activities, other than the proposed Project, may also contribute an unknown amount of anchoring in the analysis area. Cumulatively, anchoring impacts on coastal habitats associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be localized, temporary, and **minor** to **moderate**, but could be permanent if they occur in eelgrass beds or hard bottom.
EMF	EMFs continuously emanate from existing telecommunication and electrical power transmission cables. The only existing cable in the geographic analysis area for coastal habitats is the Nantucket power transmission cable #2. New cables generating EMFs are infrequently installed in the analysis area. See Sections 3.3 and 3.4 for a discussion of the nature of potential impacts. The extent of impacts is likely less than 50 feet (15.2 meters) from the cable, and the intensity of impacts on coastal habitats is likely undetectable.	No future activities were identified within the geographic analysis area for coastal habitats other than ongoing activities.	EMF would emanate from operating transmission cables if any enter the geographic analysis area for coastal habitats. See Sections 3.3 and 3.4 for a discussion of the nature of potential impacts. Submarine power cables in the analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMFs resulting from cable operation to low levels. EMFs of any two sources would not overlap, because developers typically allow at least 330 feet (100 meters) spacing between cables, EMF strength diminishes rapidly with distance, and potentially meaningful EMFs would likely extend less than 50 feet (15.2 meters) from the cable(s). The intensity of impacts on coastal habitats would likely be undetectable.	During operations, the Proposed Action would emit EMFs from the portion of transmission cables in the geographic analysis area for coastal habitats. See Sections 3.3 and 3.4 for a discussion of the nature of potential impacts. The extent of the EMFs would likely be less than 50 feet (15.2 meters) from the cable(s), and the intensity of impacts on coastal habitats would likely be **negligible**.	EMFs from the Proposed Action would cause **negligible** impacts on coastal habitats. Impacts of EMFs from existing operating cables on coastal habitats are undetectable. The impact of EMFs from future offshore wind activities on coastal habitats would likely be undetectable. Cumulative impacts of EMFs on coastal habitats associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities within the geographic analysis area would likely be **negligible.**
Light: Vessels	Navigation lights and deck lights on vessels would be a source of ongoing light. See Sections 3.3 and 3.4 for a discussion of the nature of potential impacts. The extent of impacts is limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats is likely undetectable.	Light is expected to continue to increase gradually with increasing vessel traffic over the next 30 years. See Sections 3.3 and 3.4 for a discussion of the nature of potential impacts. The extent of impacts would likely be limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats would likely be undetectable.	Light from navigation lights on vessels transiting between berths in coastal locations to and from nearshore and offshore work locations (e.g., installation, operations, maintenance of nearshore cables; construction, operations, maintenance of offshore facilities) or from vessels installing cables, if any, in the analysis area could occur primarily during construction, but also during operations and decommissioning. See Sections 3.3 and 3.4 for a discussion of the nature of potential impacts. The extent of impacts would likely be limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats would likely be undetectable.	Light from navigation lights on vessels transiting between berths in coastal locations to and from nearshore and offshore wind locations (e.g., installation, operations, maintenance of nearshore cables; construction, operations, maintenance of offshore facilities). See Sections 3.3 and 3.4 for a discussion of the nature of potential impacts. The extent of impacts would likely be limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats would likely be **negligible**.	Light from vessels from the Proposed Action would cause **negligible** impacts on coastal habitats. Impacts on coastal habitats of light from vessels related to ongoing and future non-offshore wind activities are undetectable. Impacts on coastal habitats of light from vessels related to future offshore wind activities would likely be undetectable. Cumulative impacts on coastal habitats of light from vessels within the geographic analysis area associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be **negligible**.
Light: Structures	Ongoing lights from navigational aids and other structures onshore and nearshore. See Sections 3.3 and 3.4 for a discussion of the nature of potential impacts. The extent of impacts is likely limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats is likely undetectable.	No future activities were identified within the geographic analysis area for coastal habitats other than ongoing activities.	Onshore/nearshore structures associated with offshore wind (e.g., construction and/or operations and maintenance facilities) may produce light in marinas/berthing facilities during operations of those facilities. Habitat in these locations would likely already be subjected to light impacts. See Sections 3.3 and 3.4 for a discussion of the nature of potential impacts. The extent of impacts would likely be limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats would likely be undetectable.	The Proposed Action would not result in new lighted structures within the geographic analysis area for coastal habitats and therefore, would have no impact on coastal habitats.	The Proposed Action would not result in new lighted structures within the geographic analysis area for coastal habitats; therefore, there will be no impact. Impacts on coastal habitats of light from structures related to ongoing and future non-offshore wind activities are undetectable. Impacts on coastal habitats of light from structures related to future offshore wind activities would likely be undetectable. No cumulative impacts of this sub-IPF on coastal habitats can be attributed to the Proposed Action, although light from existing structures and future offshore wind-related structures onshore or nearshore may reach coastal habitats near shore.
New cable emplacement/ maintenance	The only existing cable in the geographic analysis area is the Nantucket power transmission cable #2. Ongoing cable maintenance activities infrequently disturb bottom sediments; these disturbances are local and limited to the emplacement corridor (see the Sediment deposition and burial IPF).	No future activities were identified within the geographic analysis area other than ongoing activities.	New offshore submarine cables associated with the expanded cumulative scenario could cause short-term disturbance of seafloor habitats if one or more cable routes enter(s) the analysis area. If routes intersect eelgrass or hard-bottom habitats, impacts may be long-term to permanent (see the Sediment deposition and burial IPF). Any dredging necessary before cable installation could also contribute further impacts, especially to eelgrass beds and hard-bottom habitats.	During construction, the Proposed Action would cause short-term disturbance of seafloor habitats; impacts on hard-bottom habitat would likely be permanent. Vineyard Wind estimated that up to 117 acres (0.5 km^2) of sea floor within the OECC could be disturbed during cable installation, although some of these areas would lie outside the geographic analysis area for coastal habitats. Overall, these impacts would likely be **minor** to **moderate**. (See the IPFs of Seabed profile alterations and Sediment deposition and burial.)	The Proposed Action estimated that up to 117 acres (0.5 km^2) of sea floor within the OECC could be disturbed during cable installation, although some of these areas would lie outside the geographic analysis area for coastal habitats, leading to localized, short-term to permanent, **minor** to **moderate** impacts on seafloor habitats. Ongoing and future non-offshore wind activities, if any, that involve cables in the analysis area may cause short-term impacts. Future offshore wind activities other than the proposed Project would cause similar impacts where they overlap the analysis area. Cumulative impacts on coastal habitats associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be localized, short-term to permanent, and **minor** to **moderate** disturbances of seafloor habitats.
Noise: Onshore/offshore construction	Ongoing noise from construction occurs frequently near shores of populated areas in New England and the mid-Atlantic, but infrequently offshore. Noise from construction near shore is expected to gradually increase over the next 30 years in line with human population growth along the coast of the geographic analysis area. The intensity and extent of noise from construction is difficult to	No future activities were identified within the analysis area other than ongoing activities.	Noise from offshore wind construction activities is not expected to reach the geographic analysis area.	Noise from Vineyard Wind construction activities is not expected to reach the geographic analysis area, and therefore would have no impact on coastal habitats.	The Proposed Action would have no impacts on coastal habitats through construction noise. Construction noise from ongoing activities does cause temporary local impacts on coastal habitats. Future offshore wind would not cause impacts on coastal habitats in the analysis area through construction noise. No cumulative impacts of this sub-IPF on coastal habitats can be attributed to the Proposed Action, although ongoing activities are expected to result in local temporary impacts.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	generalize, but impacts are local and temporary.				
Noise: G&G	Site characterization surveys and scientific surveys are ongoing. The intensity and extent of the resulting impacts are difficult to generalize, but are local and temporary.	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 30 years. Seismic surveys used in oil and gas exploration create high-intensity impulsive noise that penetrates deep into the seabed. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize, but are likely local and temporary.	G&G surveys are anticipated to occur intermittently over an assumed 4-year construction period in the geographic analysis area. G&G noise resulting from offshore wind site characterization surveys is less intense than G&G noise from seismic surveys used in oil and gas exploration. The intensity and extent of the resulting impacts are difficult to generalize, but are likely local and temporary.	Noise from G&G surveys may occur during inspection and/or monitoring of cable routes, likely leading to temporary, **negligible** impacts in the immediate vicinity of the cable routes.	G&G survey noise from the Proposed Action may result in localized, temporary, **negligible** impacts on coastal habitats along the cable routes during inspection. Ongoing and future non-offshore wind impacts may result in similar types of impacts as the Proposed Action over an unknown extent. Future offshore wind activities (other than the Proposed Action), if they enter the geographic analysis area, would likely result in impacts similar to those of the Proposed Action. All G&G noise would be temporary and it would likely not occur simultaneously from multiple sources in the analysis area. The cumulative impact of G&G noise on coastal habitats associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be **negligible**.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can reach coastal habitats. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the analysis area other than ongoing activities.	Noise from pile driving is not expected to be noticeable within the geographic analysis area. Based on estimates from the COP Section 4.2.3 (Volume III; Epsilon 2018a; Pyć et al. 2018), sound pressure levels of 150 decibels are likely to extend no more than 5.7 miles (8.0 kilometers) around each pile-driving location. Based on the distance of all lease areas from the geographic analysis area, the intensity of impacts on coastal habitats would likely be undetectable.	Noise from pile driving for the Proposed Action is not expected to be noticeable within the geographic analysis area. Sound pressure levels of 150 decibels are likely to extend no more than 5.7 miles around each pile-driving location. Because the closest proposed foundation location is more than 11 miles from the geographic analysis area, the Proposed Action would have no impact on coastal habitats through pile-driving noise.	The Proposed Action would have no impact on coastal habitat through pile-driving noise. Ongoing activities may involve nearshore pile driving, which would cause temporary local impacts. Future offshore wind activities would not cause impacts on coastal habitat through pile-driving noise. No cumulative impacts of this sub-IPF on coastal habitats can be attributed to the Proposed Action, although ongoing activities may result in local temporary impacts.
Noise: Cable laying/trenching	Rare but ongoing trenching for pipeline and cable laying activities emits noise; cable burial via jet embedment also causes similar noise impacts. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise on coastal habitats are discountable compared to the impacts of the physical disturbance and sediment suspension.	New or expanded submarine cables and pipelines may occur in the geographic analysis area infrequently over the next 30 years. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise on coastal habitats are discountable compared to the impacts of the physical disturbance and sediment suspension.	Noise from trenching of export cables could reach the geographic analysis area; cable burial via jet embedment also causes similar noise impacts. This noise is anticipated to occur intermittently over an assumed 4-year construction period in the geographic analysis area. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise on coastal habitats are discountable compared to the impacts of the physical disturbance and sediment suspension.	Noise from trenching of export cables may occur during construction, although most of the export cables would be installed using a trenchless jet plowing method. Trenching noise would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension. Noise from trenching would likely have **negligible** impacts on coastal habitats. Cable burial via jet embedment also causes similar noise impacts.	The Proposed Action would likely have **negligible** impacts on coastal habitat through trenching noise, if the Proposed Action uses trenching at all. The impact on coastal habitats of trenching noise associated with ongoing activities, future non-offshore wind activities, and future offshore wind activities is discountable compared to the impacts of the physical disturbance and sediment suspension. The cumulative impact of trenching noise on coastal habitats associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be **negligible**. Cable burial via jet embedment also causes similar noise impacts.
Presence of structures: Habitat conversion	Various structures, including pilings, piers, towers, riprap, buoys, and various means of hard protection, are periodically added to the seascape, creating uncommon relief in a mostly flat seascape and converting previously existing habitat (whether hard-bottom or soft-bottom) to a type of hard habitat, although it differs from the typical hard-bottom habitat in the analysis area, namely, coarse substrates in a sand matrix. The new habitat may or may not function similarly to hard-bottom habitat typical in the region (Kerckhof et al. 2019; HDR 2019). Soft bottom is the dominant habitat type on the OCS, and structures do not meaningfully reduce the amount of soft-bottom habitat available (Guida et al. 2017; Greene et al. 2010). Structures can also create an artificial reef effect, attracting a different community of organisms.	Any new cable or pipeline installed in the geographic analysis area would likely require hard protection atop portions of the route (see cells to the left). Such protection is anticipated to increase incrementally over the next 30 years. Where cables would be buried deeply enough that protection would not be used, presence of the cable would have no impact on coastal habitats.	Any new cable installed in the geographic analysis area would likely require hard protection atop portions of the route (see cells to the left). Cable protection is anticipated to be added incrementally over an assumed 4-year construction period in the geographic analysis area. Where cables would be buried deeply enough that protection would not be used, presence of the cable would have no impact on coastal habitats. No foundations or other large offshore wind structures would be built within the geographic analysis area for coastal habitats.	The Proposed Action estimated that up to 35 acres (0.1 km^2) of cable corridor within the OECC would need protection, although some of this would occur outside the geographic analysis area for coastal habitats. Cable protection could remain permanently after cable installation (see cells to the left). The direct and indirect impacts of this sub-IPF on coastal habitats would likely be **minor beneficial**. No foundations or other large offshore wind structures would be built within the geographic analysis area for coastal habitats.	The Proposed Action is expected to cause local, **minor beneficial** impacts on coastal habitats through this sub-IPF up to 35 acres (0.1 km^2) within the OECC, although some of this would occur outside the geographic analysis area for coastal habitats. Existing structures and future non-offshore wind structures are also expected to cause localized impacts on coastal habitats through this sub-IPF. Offshore wind structures other than those associated with the proposed Project are also expected to cause localized impacts on coastal habitats through this sub-IPF. Cumulatively, this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities is anticipated to cause local, permanent, **minor beneficial** impacts on coastal habitats.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Transmission cable infrastructure	Various means of hard protection atop existing cables can create uncommon hard-bottom habitat. Where cables are buried deeply enough that protection is not used, presence of the cable has no impact on coastal habitats. The only existing cable in the geographic analysis area is the Nantucket power transmission cable #2.	See above.	See above.	See above.	See above.
Land disturbance: Erosion and sedimentation	Ongoing development of onshore properties, especially shoreline parcels, periodically causes short-term erosion and sedimentation of coastal habitats.	No future activities were identified within the geographic analysis area other than ongoing activities.	If cable landfall sites are within the geographic analysis area, erosion and sedimentation could occur. This could occur primarily during construction and decommissioning, with sporadic events within those windows. The staggered nature of construction activities would limit the total erosion and sedimentation contribution at any given time, allowing coastal habitats to recover between events.	Erosion and sedimentation are possible at the landfall site during construction if open-cut methods are used, resulting in localized, temporary, **negligible** impacts on coastal habitats.	The Proposed Action may cause erosion and sedimentation at the landfall site, resulting in localized, temporary, **negligible** impacts on coastal habitats at the landfall site. Ongoing and future non-offshore wind activities periodically cause short-term erosion and sedimentation of coastal habitats. Future offshore wind activities other than the Proposed Action could cause erosion and sedimentation if cable landfall sites are within the geographic analysis area. Overall, cumulative impacts on coastal habitats from erosion and sedimentation associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are anticipated to be **negligible** to **minor**.
Land disturbance: Onshore construction	Ongoing development of onshore properties, especially shoreline parcels, periodically causes short-term to permanent degradation of onshore coastal habitats.	No future activities were identified within the geographic analysis area other than ongoing activities.	If cable landfall sites and/or onshore transmission routes are within the geographic analysis area, localized degradation of onshore coastal habitats could occur during construction.	The Proposed Action would not involve onshore construction within the geographic analysis area for coastal habitats, and therefore, would have no impact.	The Proposed Action would not cause impacts on coastal habitat through onshore construction, resulting in no impact on coastal habitats. Ongoing activities involving onshore construction cause short-term to permanent degradation of onshore coastal habitats. Future offshore wind activities other than the Proposed Action could cause impacts on coastal habitats through onshore construction if cable landfall sites and/or onshore transmission routes are within the geographic analysis area. No cumulative impact of this sub-IPF on coastal habitats can be attributed to the Proposed Action, although ongoing and activities may result in short-term to permanent local impacts.
Land disturbance: Onshore, land use changes	Ongoing development of onshore properties, especially shoreline parcels, periodically causes the conversion of onshore coastal habitats to developed space.	No future activities were identified within the geographic analysis area other than ongoing activities.	If cable landfall sites and/or onshore transmission routes are within the geographic analysis area, localized land use changes could occur during construction and could be permanent.	The Proposed Action would not involve land use changes within the geographic analysis area for coastal habitats, and therefore would have no impact.	The Proposed Action would have no impact on coastal habitat through onshore land use changes. Ongoing activities involving this sub-IPF periodically cause the permanent conversion of onshore coastal habitats to developed space. Future offshore wind activities other than the Proposed Action could cause impacts on coastal habitats through this sub-IPF if cable landfall sites and/or onshore transmission routes are within the geographic analysis area. No cumulative impact of this sub-IPF on coastal habitats can be attributed to the Proposed Action, although ongoing and activities may result in permanent local impacts.
Seabed profile alterations	Ongoing sediment dredging for navigation purposes results in localized, short-term impacts on coastal habitats through this IPF. For example, the Town of Barnstable and Barnstable County typically undertake 10 to 20 dredging projects per year (Barnstable County Undated; CapeCod.com 2019). Dredging typically occurs only in sandy or silty habitats, which are abundant in the analysis area and are quick to recover from disturbance. Therefore, such impacts, while locally intense, have little effect on the general character of coastal habitats.	No future activities were identified within the geographic analysis area other than ongoing activities.	If dredging is used in the course of cable installation within the cumulative impacts geographic analysis area, localized short-term impacts on coastal habitats could result. Dredging typically occurs only in sandy or silty habitats, which are abundant in the analysis area and are quick to recover from disturbance. Therefore, such impacts, while locally intense, have little effect on the general character of coastal habitats.	During construction, the Proposed Action could dredge up to 69 acres (0.3 km^2) of seafloor beyond the area affected by cable emplacement, although part of this area may lie offshore of the 3-nautical-mile seaward limit of the geographic analysis area for coastal habitats. The impacts would likely be short-term, considering the natural mobility of sand waves in the analysis area. The Proposed Action would not dredge in eelgrass beds or hard-bottom habitats. Overall, the impacts on coastal habitats from this IPF would be **minor**.	The Proposed Action could dredge up to 69 acres (0.3 km^2) of seafloor beyond the area affected by cable emplacement, although part of this area may lie outside the geographic analysis area, likely leading to short-term, **minor** impacts on coastal habitats. Ongoing activities cause similar impacts, but with an unknown extent. Future offshore wind activities other than the Proposed Action could also cause similar impacts over an area that is unknown but would likely be similar to the area affected by the Proposed Action. Cumulative impacts of this IPF on coastal habitats associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities within the analysis area are likely to be **minor**.
Sediment deposition and burial	Ongoing sediment dredging for navigation purposes results in fine sediment deposition within coastal habitats. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local, limited to the emplacement corridor. No dredged material disposal sites were identified within the geographic analysis area.	No future activities were identified within the geographic analysis area other than ongoing activities.	If any dredging occurs in the analysis area, dredged material disposal during construction would cause temporary, localized turbidity increases and long-term sedimentation or burial at the immediate disposal site. These impacts would likely be short-term to long-term. Cable emplacement and maintenance activities in or near the analysis area during construction or maintenance of future offshore wind projects could cause sediment suspension for 4 to 6 hours at a time. The areal extent of such impacts is unknown but would likely be similar to the area affected by the Proposed Action. The area with a cumulatively greater sediment deposition from simultaneous activities would be limited.	The Proposed Action would cause short-term and localized turbidity increases and sediment deposition due to dredged material disposal and cable installation (including pre-lay dredging) during construction. Sediment deposition greater than 0.8 inch (20 millimeters) may extend up to 0.5 mile (0.9 kilometer) from each disposal site and cover up to 34.6 acres (0.1 km^2) (COP Appendix III-A; Epsilon 2018a). Deposition of 0.04 to 0.2 inch (1 to 5 millimeters) of sediment could potentially be deposited on up to 2,594 acres (10.5 km^2). Part of this area would lie outside the geographic analysis area. These impacts would likely be short-term to long-term. The Proposed Action would not dredge in, or dispose of, dredged material in eelgrass beds or hard-bottom habitats. Installation of submarine cable would mostly be done by jet or mechanical plow. The resultant plume is predicted to stay in the lower portion of the water column (the bottom 9.8 feet [2.7 meters]). The portion of the plume that exceeds 10 mg/L	The Proposed Action would cause sediment deposition on up to 2,594 acres (10.5 km^2), although part of this area would lie outside the geographic analysis area for coastal habitats; however, sediment deposition would have no impact on coastal habitats outside eelgrass beds and hard-bottom habitats, where the impacts would be **minor**. The Proposed Action would not dredge in, or dispose of, dredged material in eelgrass beds or hard-bottom habitats. Ongoing activities cause similar impacts over an unknown extent. Future offshore wind activities (other than the Proposed Action), if they enter the analysis area, could also cause similar impacts over an area that is unknown but would likely be similar to the area affected by the Proposed Action. Cumulative impacts of sediment deposition and burial on coastal habitats within the analysis area associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are likely to be **minor**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
				typically would extend 656 feet (199.9 meters) from the route centerline but could extend up to 1.2 miles (1.6 kilometers). Modeling showed that sediment concentrations greater than 10 mg/L from dredging could extend up to 10 miles (16 kilometers) from the route centerline and spread through the entire water column. These plumes typically settled within 3 hours but could persist in small areas (15 acres [60,702.8 m^2] or less) for up to 6 to 12 hours (Epsilon 2018c). Dredged material disposal could cause concentrations greater than 1,000 mg/L for a duration of less than 2 hours and a distance of approximately 3 miles (5 kilometers). For this reason, Vineyard Wind expects to use dredging only when necessary in sand wave areas, and not at all within Lewis Bay. A predicted maximum of 3.8 miles (6.1 kilometers) of dredging may occur in the OECC (Table 1-5 in Epsilon 2018c). Attachment C of Epsilon (2018c) depicts potential areas of discontinuous dredging. Although turbidity is likely to be high in the affected areas, sediment deposition would have no impact outside eelgrass beds and hard-bottom habitats. Overall, the impacts on coastal habitats from this IPF would be **minor**.	
Climate change: Ocean acidification	Ongoing CO_2 emissions causing ocean acidification may contribute to reduced growth or the decline of reefs and other habitats formed by shells.	No future activities were identified within the geographic analysis area other than ongoing activities.	Impacts are the same as under ongoing activities to the left. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under ongoing activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF would contribute to the reduced growth or decline of some types of coastal habitats. Because this sub-IPF is a global phenomenon, impacts on coastal habitats through this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change. The intensity of impacts resulting from climate change are uncertain, but are anticipated to qualify as **minor** to **moderate**.
Climate change: Warming and sea level rise, altered habitat/ecology	Climate change, influenced in part by ongoing greenhouse gas emissions, is expected to continue to contribute to a widespread loss of shoreline habitat from rising seas and erosion. In submerged habitats, warming is altering ecological relationships and the distributions of ecosystem engineer species, likely causing permanent changes of unknown intensity gradually over the next 3 years.	See above.	See above.	See above.	See above.

BOEM = Bureau of Ocean Energy Management; COP = Construction and Operations Plan; EIS = Environmental Impact Statement; EMF = electromagnetic field; G&G = Geological and Geophysical; IPF = impact-producing factors; km^2 = square kilometers; m^2 = square meter; mg/L = milligrams per liter; OCS = Outer Continental Shelf; OECC = offshore export cable corridor; SSU = special, sensitive, and unique

Table 3.3-1: Summary of Activities and the Associated Impact-Producing Factors for Benthic Resources

Baseline Conditions: The geographic analysis area is located within the greater Georges Bank area (though not part of the bank itself) of the U.S. Northeast Shelf Large Marine Ecosystem. Typical faunal assemblages in the region include polychaetes, crustaceans (particularly amphipods), mollusks (gastropods and bivalves), echinoderms (e.g., sand dollars, brittle stars, and sea cucumbers), and various other groups (e.g., sea squirts and burrowing anemones) (Guida et al. 2017). Guida et al. (2017) reported that amphipods and polychaetes numerically dominated infaunal communities in the RI and MA Lease Areas, while sand shrimp (*Crangon septemspinosa*) and sand dollars dominated benthic epifaunal assemblages. Grab samples taken in 2011 south of Cape Cod found abundant nut clams, polychaetes, and amphipods, as well as oligochaetes and nemertean ribbon worms (AECOM 2012). The region experiences strong seasonal variations in water temperature and phytoplankton concentrations, with corresponding seasonal changes in the densities of benthic organisms.

The seafloor in the geographic analysis area is predominantly composed of unconsolidated sediments ranging from silt and fine-grained sands to gravel. Local hydrodynamic conditions largely determine sediment types. Parts of the geographic analysis area, particularly in the vicinity of Muskeget Channel, overlap with hard and/or complex seafloor. Hard bottom is important habitat for attachment of sessile (immobile) organisms and increases community complexity.

Studies of the Atlantic Coast from 1990 to 2010 show endemic benthic invertebrates shifting their distribution northwards in response to rising water temperatures, resulting in changes to benthic community structure (Hale et al. 2016). Historical data on Centerville Harbor, which includes Covell's Beach, show a slow decline in eelgrass bed habitat since 1951 (MassDEP 2011). Lewis Bay has experienced significant declines in eelgrass bed habitat from 1951 to 2001 from 245 to 3.6 acres (1 to 0.01 km^2) (MassDEP 2011). New England horseshoe crab stocks are in decline (ASMFC 2013). According to MA DMF (2016, 2018b), nesting horseshoe crabs use Covell's Beach and the west entrance to Lewis Bay beach from late spring to early summer. Horseshoe crabs use the waters of Lewis Bay for overwintering and to stage for spawning (MA DMF 2018a).

Commercial fishing using bottom trawls and dredge-fishing methods disturbs swaths of seafloor habitat. Fishing occurs multiple times each day in many places across the whole continental shelf. Other anthropogenic sources of bottom disturbance also occur in specific project areas, such as pipeline trenching or submarine cable emplacement.

Commercial and recreational fishing gear are periodically lost, but they can continue to capture or otherwise harm benthic resources. The lost gear, moved by currents, can disturb benthic resources, creating small, short-term, localized impacts.

Dredging for navigation, marine minerals extraction, and/or military uses disturbs swaths of seafloor habitat. Their impacts are similar in nature but much greater in extent and severity than those caused by other bottom-directed IPFs such as pipeline trenching or submarine cable emplacement that create a relatively narrow trench and backfill in the same operation.

For additional information on benthic baseline conditions, see Draft EIS Section 3.3.5.

Associated IPFs: Sub-IFPs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/ hazmat	See Appendix A Table A-8 for a discussion of ongoing accidental releases. Accidental releases of hazmat occur periodically, mostly consisting of fuels, lubricating oils, and other petroleum compounds. Because most of these materials tend to float in seawater, they rarely contact benthic resources. The chemicals with potential to sink or dissolve rapidly often dilute to non-toxic levels before they affect benthic resources. The corresponding impacts on benthic resources are rarely noticeable.	Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. See previous cell and Appendix A Table A-8 on Water Quality for details.	Accidental releases would increase under an expanded cumulative scenario. Accidental releases of hazmat mostly consist of fuels, lubricating oils, and other petroleum compounds. Because most of these materials tend to float in seawater, they are unlikely to contact benthic resources. The chemicals with potential to sink or dissolve rapidly are predicted to dilute to non-toxic levels before they would reach benthic resources. Larger spills, though unlikely, could have larger impacts on benthic resources due to larger adverse impacts on water quality. The low likelihood and small size of potential releases, along with the cleanup measures in place, indicate that these impacts on benthic resources are unlikely to be noticeable. See Appendix A Table A-8 on Water Quality for additional details.	The Proposed Action would increase the risk of accidental releases, primarily during construction but also during operations and decommissioning. Accidental releases of hazmat mostly consist of fuels, lubricating oils, and other petroleum compounds. Because most of these materials tend to float in seawater, they are unlikely to contact benthic resources. The chemicals with potential to sink or dissolve rapidly are predicted to dilute to non-toxic levels before they would reach benthic resources. The corresponding impacts on benthic resources are unlikely to be noticeable. Larger spills, though unlikely, could have larger impacts on benthic resources due to adverse impacts on water quality. The low likelihood and small size of potential releases, along with the cleanup measures in place, indicate that these impacts (mortality, decreased fitness, disease) would likely be **negligible**. See Appendix A Table A-8 on Water Quality for additional details.	Under the Proposed Action, the impacts on benthic resources from this sub-IPF would include an increased potential for a release that would have localized and temporary impacts, including mortality and decreased fitness, likely resulting in **negligible** impacts. The impacts from ongoing activities and future non-offshore wind activities stem from the increased potential for releases over the next 30 years due to increasing vessel traffic and ongoing, chronic releases. Future offshore wind activities would contribute to an increased risk of releases and impacts on benthic resources. The contribution from future offshore wind and the Proposed Action would represent a low percentage of the overall risk from ongoing activities. Cumulatively, the impacts on benthic resources (mortality, decreased fitness, disease) from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be **negligible**, localized, and temporary due to the likely limited extent and duration of a release, as described in detail in Draft EIS Section 3.2.2.3 on Water Quality. See Appendix A Table A-8 for details.
Accidental releases: Invasive species	Invasive species are periodically released accidentally during ongoing activities, including the discharge of ballast water and bilge water from marine vessels. The impacts on benthic resources (e.g., competitive disadvantage, smothering) depend on many factors, but can be noticeable, widespread, and permanent.	No future activities were identified within the geographic analysis area other than ongoing activities.	Increasing vessel traffic related to the offshore wind industry would increase the risk of accidental releases of invasive species, primarily during construction. The impacts on benthic resources depend on many factors, but could be noticeable, widespread, and permanent.	The increased vessel traffic associated with the Proposed Action, especially traffic from foreign ports, would increase the risk of accidental releases of invasive species, primarily during construction. The impacts on benthic resources depend on many factors, but could be widespread and permanent. The increase in the risk of accidental releases of invasive species attributable to the Proposed Action would be **negligible**.	The Proposed Action would cause a **negligible** increase in the risk of accidental releases of invasive species, stemming primarily from construction. Ongoing activities currently present a risk of accidental releases. Offshore wind activities other than the Proposed Action would increase this risk. Cumulatively, the risk of impacts on benthic resources due to accidental releases of invasive species associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities is anticipated to be **major**, and most of this risk comes from ongoing activities, as it is generally related to the volume of vessel traffic.
Accidental releases: Trash and debris	Ongoing releases of trash and debris occurs from onshore sources, fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying. However, there does not appear to be evidence that ongoing releases have detectable impacts on benthic resources.	No future activities were identified within the geographic analysis area other than ongoing activities.	Accidental releases of trash and debris may occur from vessels primarily during construction, but also during operations and decommissioning. BOEM assumes all vessels would comply with laws and regulations to minimize releases. In the event of a release, it would be an accidental, localized event in the vicinity of project areas. There is a higher likelihood of releases from nearshore project activities, e.g. transmission cable installation, transportation of equipment and personnel from ports. However, there does not appear to be evidence that the volumes and extents anticipated would have any detectable impact on benthic resources.	Accidental releases of trash and debris may occur from vessels primarily during construction, but also during operations and decommissioning. BOEM assumes all vessels would comply with laws and regulations to minimize releases. In the event of a release, it would be an accidental, localized event in the vicinity of project areas. There is a higher likelihood of releases from nearshore project activities, e.g. transmission cable installation, transportation of equipment and personnel from ports. However, there does not appear to be evidence that the volumes and extents anticipated would have any detectable impact on benthic resources. Therefore, the Proposed Action would likely have no impact on benthic resources through this sub-IPF.	Accidental releases of trash and debris are not likely to have any detectable impact on benthic resources. Cumulative accidental trash and debris releases associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would occur but would likely have no impact, given that there does not appear to be evidence that the volumes and extents would have any cumulative impact on benthic resources.
Anchoring	Regular vessel anchoring related to ongoing military, survey, commercial, and recreational activities continues to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. These impacts include increased turbidity levels and the potential for direct contact to cause injury and mortality of benthic resources, as well as physical damage to their habitats. All impacts are localized; turbidity is temporary; injury and mortality are recovered in the short term; and physical damage can be permanent if it occurs in eelgrass beds or hard bottom.	No future activities were identified within the geographic analysis area other than ongoing activities.	There would be increased anchoring during survey activities and during the construction and installation of offshore components. There may also be increased anchoring/mooring of met towers or buoys. These impacts would include increased turbidity levels and potential for direct contact causing mortality. Up to 56 acres (0.2 km^2) could be affected. All impacts would be localized; turbidity would be temporary; physical damage can be permanent if it occurs in eelgrass beds or hard bottom; mortality from direct contact would be recovered in the short term.	The COP estimated that anchoring would disturb up to 4.4 acres (17,806 m^2). These impacts would occur primarily during construction, but also during operations and decommissioning, and would include increased turbidity and potential for direct contact causing mortality of benthic resources. All impacts would be localized; turbidity would be temporary; physical damage can be permanent if it occurs in hard-bottom habitat; mortality from direct contact would be recovered in the short term. The Proposed Action would not anchor in eelgrass. Anchoring disturbances would recover naturally, unless they occur directly on hard bottom, which is unlikely. The overall impact of anchoring on benthic resources would be **minor** to **moderate.**	Anchoring associated with the Proposed Action would disturb up to 4.4 acres (17,806 m^2), resulting in **minor** to **moderate** temporary to short-term impacts (turbidity, mortality) on benthic resources. Ongoing and future non-offshore wind activities would cause a series of temporary localized impacts. Offshore wind activities, other than the proposed Project, would affect up to 56 acres (0.2 km^2). Cumulatively, anchoring could affect up to 60 acres (0.2 km^2), although some of this may occur after the benthic resources have recovered from the earlier impact(s), resulting in **minor** to **moderate** cumulative impacts on benthic resources. Cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be localized and temporary, but could be permanent if they occur in eelgrass beds or hard bottom.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
EMFs	EMFs continuously emanate from existing telecommunication and electrical power transmission cables. In the geographic analysis area, there are six existing power cables connecting Martha's Vineyard and Nantucket to the mainland. New cables generating EMFs are infrequently installed in the geographic analysis area. Some benthic species can detect EMFs, although EMFs do not appear to present a barrier to movement. The extent of impacts (behavioral changes) is likely less than 50 feet (15.2 meters) from the cable and the intensity of impacts on benthic resources is likely undetectable.	No future activities were identified within the geographic analysis area other than ongoing activities.	EMFs would emanate from new operating transmission cables. In the expanded cumulative scenario, an estimated 943 miles (1,518 kilometers) of cable would be added in the geographic analysis area, producing EMFs in the immediate vicinity of each cable during operation. (See cells to the left.) Submarine power cables in the geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMFs to low levels. EMFs of any two sources would not overlap because developers typically allow at least 330 feet (100 meters) between cables, even for multiple cables within a single OECC. The extent of effects would likely be less than 50 feet (15.2 meters) from the cable(s), and the intensity of impacts on benthic resources would likely be undetectable.	EMFs would emanate from operating transmission cables within the geographic analysis area. With the shielding and burial depths proposed, impacts are expected to be localized and difficult to detect, but permanent. The extent of effects would likely be less than 50 feet (15.2 meters) from the cable(s), and the intensity of impacts on benthic resources would likely be **negligible.**	EMFs from the Proposed Action are expected to lead to **negligible** impacts on benthic resources. Impacts of EMFs from existing operating cables on benthic resources are likely undetectable. Impacts of EMFs from future offshore wind activities on benthic resources would likely be undetectable. Noticeable individual or cumulative effects on benthic resources would be unlikely. Therefore, cumulative impacts of EMFs on benthic resources associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be **negligible**. Furthermore, most benthic resources are primarily not mobile or move very slowly, and thus are not susceptible to multiple exposures to EMFs. In the case of mobile species, an individual exposed to EMFs would cease to be affected when it leaves the affected area. An individual may be affected more than once during long-distance movements; however, there is no information on whether previous exposure to EMFs would influence the impacts of future exposure. EMFs do not appear to constitute a barrier to migration.
New cable emplacement/ maintenance	Cable maintenance activities infrequently disturb benthic resources and cause temporary increases in suspended sediment; these disturbances would be local and limited to the emplacement corridor. In the geographic analysis area, there are six existing power cables. See BOEM (2019b) for details. New cables are infrequently added near shore. Cable emplacement/maintenance activities injure and kill benthic resources, and result in temporary to long-term habitat alterations. The intensity of impacts depends on the time (season) and place (habitat type) where the activities occur. (See also the IPFs of Seabed profile alterations and Sediment deposition and burial.)	No future activities were identified within the geographic analysis area other than ongoing activities.	New offshore submarine cables associated with the expanded cumulative scenario would cause short-term disturbance of seafloor habitats, and injury and mortality of benthic resources in the immediate vicinity of the cable emplacement activities. The total area of direct disturbance by new cable emplacement is estimated to be up to 1,269 acres (5.1 km^2). Increased turbidity would occur during construction for 1 to 6 hours at a time over an assumed 7-year construction period in the geographic analysis area. Disturbed seafloor from construction of those projects may affect benthic resources, but assuming similar installation procedures, the duration and extent of impacts would be limited, short-term, and benthic assemblages would recover following the disturbance. If routes intersect eelgrass or hard-bottom habitats, impacts may be long-term to permanent. (See also the IPFs of Seabed profile alterations and of Sediment deposition and burial.)	The Proposed Action would cause short-term disturbance, injury, and mortality of benthic resources, and likely permanent impacts on hard-bottom habitat. The Proposed Action would not install cables through eelgrass beds. The Proposed Action is estimated to disturb up to 328 acres (1.3 km^2) of seafloor by cable installation and up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation. Cable installation would mostly be done by jet or mechanical plow. Overall, the impacts of this IPF on benthic resources would likely be **moderate**. (See also the IPFs of Seabed profile alterations and of Sediment deposition and burial.)	The COP estimated that up to 328 acres (1.3 km^2) of seafloor could be disturbed by cable installation and that up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation, potentially leading to **moderate** short-term impacts including disturbance, injury, and mortality. In most locations, the affected areas are expected to recover naturally, and impacts would be short-term, except in hard-bottom habitat, where impacts may be permanent. Ongoing and future non-offshore wind activities, if any involve cables in the geographic analysis area, may cause short-term impacts and possibly long-term habitat alterations if cables pass through hard bottom and/or eelgrass. Future offshore wind activities other than the Proposed Action would cause similar impacts across up to 1,269 acres (5.1 km^2). Cumulative impacts (disturbance, injury, mortality) on benthic resources associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be additive among sources, totaling 1,590 acres (6.4 km^2) and would likely be **moderate.**
Noise: Onshore/offshore construction	See Table 3.4-1 on finfish, invertebrates, and EFH. Detectable impacts of construction noise on benthic resources rarely, if ever, overlap from multiple sources.	See Table 3.4-1 on finfish, invertebrates, and EFH. Detectable impacts of construction noise on benthic resources would rarely, if ever, overlap from multiple sources.	See Table 3.4-1 on finfish, invertebrates, and EFH. Detectable impacts of construction noise on benthic resources would rarely, if ever, overlap from multiple sources.	Construction of up to 102 offshore structures would generate noise and temporarily impact benthic resources. The greatest impact from noise is likely to be caused by pile driving (see the Pile driving sub-IPF).	The majority of impacts from construction noise are likely to be related to pile driving (see the Pile driving sub-IPF). All other sources of construction noise would likely not lead to detectable impacts on benthic resources in the geographic analysis area.
Noise: G&G	See Table 3.4-1 on finfish, invertebrates, and EFH. Detectable impacts of G&G noise on benthic resources rarely, if ever, overlap from multiple sources.	See Table 3.4-1 on finfish, invertebrates, and EFH. Detectable impacts of G&G noise on benthic resources would rarely, if ever, overlap from multiple sources.	See Table 3.4-1 on finfish, invertebrates, and EFH. Detectable impacts of G&G noise on benthic resources would rarely, if ever, overlap from multiple sources.	Noise from G&G surveys during inspection and/or monitoring of cable routes may occur during construction and operations. G&G noise resulting from cable route surveys can disturb benthic resources in the immediate vicinity of the investigation. Impacts on benthic resources (disturbance) are anticipated to be temporary and **negligible**.	G&G survey noise from the Proposed Action may result in **negligible** temporary impacts on benthic resources along the cable routes during inspection. Ongoing and future non-offshore wind impacts may result in similar types of impacts as the Proposed Action over an unknown extent, and could possibly also result in injury or mortality during seismic surveys. Future offshore wind activities other than the Proposed Action would likely have similar impacts as the Proposed Action but across a greater area. Cumulative impacts would likely be approximately equal to the sum of all of these impacts and would be **negligible** to **minor**. Detectable impacts of G&G noise on benthic resources would rarely, if ever, overlap from multiple sources.
Noise: O&M	See Table 3.4-1 on finfish, invertebrates, and EFH.	See Table 3.4-1 on finfish, invertebrates, and EFH.	See Table 3.4-1 on finfish, invertebrates, and EFH. Noise from operational WTGs would increase noise near the WTGs. While continuous noise associated with operational WTGs may be audible to some invertebrates. 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 resources (English et al. 2017).	See Table 3.4-1 on finfish, invertebrates, and EFH. Noise from operational WTGs would increase noise near the WTGs. While continuous noise associated with operational WTGs may be audible to some invertebrates. 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 resources (English et al. 2017).	There does not appear to be evidence that noise related to operations and maintenance of offshore wind facilities would adversely affect benthic resources. The Proposed Action is not expected to cause impacts on benthic resources through this sub-IPF. Ongoing and future non-offshore wind activities may result in small local impacts on benthic resources, such as disturbance. Future offshore wind activities other than the Proposed Action are not expected to cause impacts on benthic resources through this sub-IPF. No cumulative impacts of this sub-IPF on benthic resources can be attributed to the Proposed Action (although it would increase noise near the WTGs, but not to an extent that would cause impacts), although ongoing and activities may cause small local impacts.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to benthic resources in a small area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the geographic analysis area other than ongoing activities.	Noise from pile driving would occur during installation of foundations for offshore structures. This would occur during construction for 4 to 6 hours at a time over an assumed 7-year construction period in the geographic analysis area. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to benthic resources in a limited area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. The extent depends on pile size, hammer energy, and local acoustic conditions; based on estimates from the Proposed Action, the extent of behavioral impacts is likely less than 5.7 miles (9.2 kilometers) around each pile, and the extent of mortality is assumed to cover approximately 9.7 acres (39,254 m^2) per foundation. If all 257 foundations in the expanded cumulative scenario are summed, mortality is expected to cover approximately 2,493 acres (10.1 km^2). The affected areas would likely be recolonized in the short term.	The Proposed Action would produce noise from pile driving during installation of foundations for 4 to 6 hours at a time during construction. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to benthic resources in a limited area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. The estimated extent of behavioral impacts is likely less than 5.7 miles around each pile, and the extent of mortality is assumed to cover 9.7 acres per foundation, totaling approximately 989 acres. The affected areas would likely be recolonized in the short term, and the overall impact on benthic resources would be **moderate**.	Noise from pile driving during construction of the Proposed Action is expected to cause **moderate** short-term impacts, with potential injury or mortality occurring across approximately 989 acres (2 km^2) of the seafloor. Ongoing and future non-offshore wind activities may have similar effects, perhaps with a smaller extent. Future offshore wind activities other than the Proposed Action could cause potential injury or mortality across approximately 2,493 acres (10.1 km^2). The cumulative area affected by pile-driving noise would be the sum of all of these affected areas and is expected to include potential injury or mortality across approximately 3,482 acres (14.1 km^2). The cumulative impact of pile-driving noise on benthic resources associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be **moderate**. If multiple piles are driven simultaneously, the areas of potential injury or mortality would not overlap. The areas of behavioral impacts may overlap; although the noises from driving multiple piles are unlikely to overlap at any one time, individuals may be affected by noise from sequential events before they have fully recovered from previous exposures.
Noise: Cable laying/trenching	Infrequent trenching activities for pipeline and cable laying, as well as other cable burial methods, emit noise. These disturbances are local, temporary, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	New or expanded submarine cables and pipelines are likely to occur in the geographic analysis area. These disturbances would be infrequent over the next 30 years, local, temporary, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	Noise from trenching/burial of inter-array and export cables would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension. This noise would be intermittent and would occur over an assumed 7-year construction period in the geographic analysis area.	Noise from trenching of export cables may occur during construction, although most of the export cables would be installed using a trenchless jet plowing method. The jet plowing method also creates noise. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension. This noise would likely have **negligible** impacts on benthic resources.	The Proposed Action would likely have **negligible** impacts on benthic resources through trenching/cable burial noise. The impact on benthic resources of this type of noise associated with ongoing activities, future non-offshore wind activities, and future offshore wind activities is discountable compared to the impacts of the physical disturbance and sediment suspension. The cumulative impact of this noise on benthic resources associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be **negligible**.
Port utilization: Expansion	See Table 3.4-1 on finfish, invertebrates, and EFH.	See Table 3.4-1 on finfish, invertebrates, and EFH.	Increases in port utilization due to other offshore wind energy projects would lead to increased vessel traffic. This increase in vessel traffic would be at its peak during construction activities over a 7-year period and would decrease during operations but increase again during decommissioning. In addition, any related port expansion and construction activities related to the additional offshore wind projects would add to the total amount of disturbed benthic area, resulting in disturbance and mortality of individuals and temporary to permanent habitat alteration. At least one project is contemplating port expansion/modification in Vineyard Haven. Ports have already affected benthic resources, and future port projects would implement BMPs to minimize impacts. Therefore, the degree of impacts on benthic resources would likely be undetectable in the geographic analysis area.	The Proposed Action is not anticipated to cause any port expansion or otherwise affect benthic resources near ports. Therefore, there would be no impact on benthic resources from this sub-IPF.	The Proposed Action is not anticipated to cause any port expansion or otherwise affect benthic resources near ports. Ongoing and future non-offshore wind activities are expected to cause impacts through this sub-IPF on benthic resources that are difficult to detect. Future offshore wind activities other than the Proposed Action are expected to cause impacts through this sub-IPF on benthic resources that are difficult to detect. No cumulative impacts of this sub-IPF on benthic resources can be attributed to the Proposed Action, although ongoing and activities are expected to result in difficult to detect impacts on benthic resources.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear are periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb, injure, or kill benthic resources, creating small, short-term, localized impacts.	Future new cables, perhaps connecting Martha's Vineyard and/or Nantucket to the mainland, would present additional risk of gear loss, resulting in small, short-term, localized impacts (disturbance, injury).	Development of the projects in the expanded cumulative scenario would install more buoys, met towers, foundations, and hard protection incrementally over an assumed 7-year construction period in the geographic analysis area, and the structures would remain until decommissioning of each project is complete. In the expanded cumulative scenario, there could be up to 257 new foundations, 219 acres (0.9 km^2) of foundation scour protection, and 250 acres (1.1 km^2) of new hard protection atop cables. This would increase the risk of gear loss/damage by entanglement and the ensuing impacts on benthic resources (disturbance, injury). The intermittent impacts at any one location would likely be short-term and localized, although the risk of occurrence would persist as long as the structures remain.	The Proposed Action would add up to 102 foundations, 53 acres (0.2 km^2) of scour protection and 98 acres (0.4 km^2) of cable protection. This would permanently increase the risk of gear loss/damage by entanglement and the ensuing impacts (disturbance, injury) on benthic resources as long as the structures remain. The intermittent impacts at any one location would likely be localized, short-term, and **negligible**, and the risk of occurrence would persist as long as the structures remain.	The risk of impacts from this sub-IPF is proportional to the amount of structure present. The Proposed Action would add up to 102 foundations, 53 acres (0.2 km^2) of scour protection and 98 acres (0.4 km^2) of cable protection, resulting in **negligible** impacts (disturbance, injury) on benthic resources through this sub-IPF. Ongoing entanglement and gear loss/damage at existing structures also periodically results in short-term, localized impacts. Future offshore wind activities other than the Proposed Action would add approximately 219 acres (0.9 km^2) of scour protection, 250 acres (1.1 km^2) of cable protection, and the vertical surfaces of up to 257 new foundations. Cumulatively, up to 359 foundations, 272 acres (1.1 km^2) of scour protection, and 348 acres (1.4 km^2) of cable protection would increase the risk of periodic short-term, highly localized impacts; the cumulative impact on benthic resources through this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be **negligible**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Hydrodynamic disturbance	See Table 3.4-1 on finfish, invertebrates, and EFH.	See Table 3.4-1 on finfish, invertebrates, and EFH.	See above for quantification and timing. New structures, especially foundations, would disturb hydrodynamics as long as the structures remain. Impacts would likely be highly localized and difficult to detect. BMPs would be in place to minimize scour; therefore, sediment plumes, if any, would return to baseline conditions in the area and would not likely have a detectable impact. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood. See Table 3.4-1 on finfish, invertebrates, and EFH.	See above for quantification and timing. See Table 3.4-1 on finfish, invertebrates, and EFH for additional details on the nature of potential impacts. COP Appendix III-K (Epsilon 2018a) discusses local hydrodynamic forces. The WTG and ESP foundations result in localized alterations of water currents, but the low current speeds at the seabed in the lease area and minimal seabed mobility lower scour concerns. Overall, BOEM anticipates the Proposed Action would cause a **negligible** impact on benthic resources through this sub-IPF.	See above for quantification and timing. The Proposed Action is expected to cause small local disturbances, resulting in **negligible** impacts on benthic resources. Existing structures and future non-offshore wind structures also cause localized disturbances, but not to a degree that results in detectable impacts on benthic resources. Other offshore wind structures would also cause localized disturbances, resulting in little to no impact on benthic resources. Cumulatively, this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities is anticipated to cause permanent, highly localized changes that have a **negligible** impact on benthic resources.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables continuously create uncommon relief in a mostly sandy seascape. Structure-oriented fishes are attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes can adversely affect populations and communities of benthic resources. These impacts are local and permanent.	New cables installed in the geographic analysis area over the next 30 years would likely require hard protection atop portions of the route (see the "new cable emplacement/maintenance" row in this table). Any new towers, buoy, or piers would also create uncommon relief in a mostly flat, sandy seascape. Structure-oriented fishes could be attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes could adversely affect populations and communities of benthic resources. These impacts are expected to be local and to be permanent as long as the structures remain.	See above for quantification and timing. Structure-oriented fishes could be attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes could adversely affect populations and communities of benthic resources. These impacts are expected to be local and permanent as long as the structures remain.	See above for quantification and timing. Structure-oriented fishes could be attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes could adversely affect populations and communities of benthic resources. These impacts are expected to be local, permanent, and **minor** as long as the structures remain.	See above for quantification and timing. The Proposed Action is expected to cause localized **minor** impacts (increased predation) on benthic resources. Existing structures and future non-offshore wind structures also cause small, localized impacts of this type. Other offshore wind structures would also cause localized impacts of this type. Cumulatively, this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities is anticipated to cause permanent, highly localized changes that have **minor** impacts on benthic resources as long as the structures remain.
Presence of structures: Habitat conversion	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables continuously provide uncommon hard-bottom habitat. A large portion is homogeneous sandy seascape but there is some other hard and/or complex habitat. Benthic species dependent on hard-bottom habitat can benefit on a constant basis, although the new habitat can also be colonized by invasive species (e.g., certain tunicate species). Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat.	See above for quantification and timing. Any new towers, buoy, piers, or cable protection structures would create uncommon relief in a mostly sandy seascape. Benthic species dependent on hard-bottom habitat could benefit, although the new habitat could also be colonized by invasive species (e.g., certain tunicate species). Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010).	See above for quantification and timing. Benthic species dependent on hard-bottom habitat could benefit, although the new habitat could also be colonized by invasive species (e.g., certain tunicate species). Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). These impacts are expected to be local and permanent as long as the structures remain.	See above for quantification and timing. Benthic species dependent on hard-bottom habitat could benefit (Claisse et al. 2014; Smith et al. 2016), although the new habitat could also be colonized by invasive species (e.g., certain tunicate species). Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). These impacts on benthic resources would be both beneficial and adverse, likely resulting in a net **moderate beneficial**, local, and permanent impact.	See above for quantification and timing. The Proposed Action is expected to cause localized impacts that would be both beneficial and adverse, likely resulting in a net **moderate beneficial** impact. Existing structures and future non-offshore wind structures are also expected to cause localized impacts on benthic resources through this sub-IPF. Offshore wind structures other than those associated with the Proposed Action are also expected to cause localized impacts on benthic resources through this sub-IPF. Cumulatively, this sub-IPF is anticipated to cause many permanent local impacts on benthic resources that may be beneficial. Overall, the cumulative impacts of this sub-IPF on benthic resources associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are anticipated to be **moderate beneficial**.
Presence of structures: Transmission cable infrastructure	The presence of transmission cable infrastructure, especially hard protection atop cables, causes impacts through entanglement/gear loss/damage, fish aggregation, and habitat conversion. Therefore, see those sub-IPFs within Presence of structures.	See other sub-IPFs within Presence of structures.	See other sub-IPFs within Presence of structures.	See other sub-IPFs within Presence of structures.	See other sub-IPFs within Presence of structures.
Discharges	The gradually increasing amount of vessel traffic is increasing the cumulative permitted discharges from vessels. Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated. However, there does not appear to be evidence that the volumes and extents have any impact on benthic resources.	There is the potential for new ocean dumping/dredge disposal sites in the Northeast. Impacts (disturbance, reduction in fitness) of infrequent ocean disposal to benthic resources are short-term because spoils are typically recolonized naturally. In addition, the USEPA has established dredge spoil criteria and it 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 would be increased potential for discharges from vessels during construction, operations, and decommissioning. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. There would be an increase in these wastes, particularly during construction and decommissioning but the discharges would be staggered over time and localized. Permitted discharges of dredged material may also increase. There does not appear to be evidence that the volumes and extents anticipated would have any impact on benthic resources.	Permitted discharges from the Proposed Action would include uncontaminated water and treated liquid wastes. There does not appear to be evidence that the volumes and extents anticipated would have any impact on benthic resources. Therefore, the Proposed Action is anticipated to cause no impact on benthic resources through discharges.	The Proposed Action is anticipated to cause no impact on benthic resources through discharges. Ongoing and future non-offshore wind activities may cause short-term local impacts (disturbance, reduction in fitness) through this IPF. Future offshore wind activities other than the Proposed Action are expected to cause little to no impact on benthic resources through this IPF. No cumulative impacts of this IPF on benthic resources can be attributed to the Proposed Action, although future non-offshore wind activities may cause short-term local impacts. Overall, these impacts would fall within the range of impacts from ongoing activities. Any new ocean disposal sites would not overlap the corresponding impacts of the Proposed Action. Many discharges are required to comply with permitting standards, established to ensure discharge potential impacts on the environment are mitigated.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Regulated fishing effort	Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by Massachusetts, towns, and/or NOAA, depending on jurisdiction, affect benthic resources by modifying the nature, distribution and intensity of fishing-related impacts, including those that disturb the seafloor (trawling, dredge fishing).	No future activities were identified within the geographic analysis area other than ongoing activities.	Offshore wind development could indirectly influence this IPF. Offshore wind development could indirectly influence this IPF (Section 3.11), possibly indirectly influencing when, where, and to what degree fishing activities affect benthic resources.	The Proposed Action could indirectly influence this IPF (Section 3.11), possibly indirectly influencing when, where, and to what degree fishing activities affect benthic resources.	Regulated fishing effort can affect benthic resources by modifying the nature, distribution, and intensity of fishing-related impacts (mortality, bottom disturbance; Section 3.11). The indirect impacts of regulated fishing effort (disturbance, mortality) through its influence on bottom-directed fishing gear may contribute to cumulative impacts from other IPFs that result in seafloor disturbance. The intensity of impacts on benthic resources under future fishing regulations are uncertain, but would likely be similar to or less than under the *status quo*, and would likely qualify as **moderate**.
Seabed profile alterations	Ongoing sediment dredging for navigation purposes results in localized short-term impacts (habitat alteration, injury, and mortality) on benthic resources through this IPF. For example, the Town of Barnstable and Barnstable County typically undertake 10 to 20 dredging projects per year. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance. Therefore, such impacts, while locally intense, have little impact on benthic resources in the geographic analysis area.	No future activities were identified within the geographic analysis area other than ongoing activities.	Dredging and/or mechanical trenching used in the course of cable installation can cause localized short-term impacts (habitat alteration, injury, and mortality) through seabed profile alterations, as well as through sediment deposition. Assuming the extent of such impacts is proportional to the length of cable installed, such impacts from future offshore wind activities would likely be on the order of 3 times more than under the Proposed Action alone. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance. Mechanical trenching, used in more resistant sediments (e.g., gravel, cobble), causes seabed profile alterations during use, although the seabed is typically restored to its original profile after cable installation in the trench. Therefore, seabed profile alterations, while locally intense, have little impact on benthic resources in the geographic analysis area.	During construction, the Proposed Action could dredge up to 69 acres (0.3 km^2) of seafloor beyond the area affected by cable emplacement, potentially leading to short-term impacts including habitat alteration, injury, and mortality. The impacts would likely be short-term, considering the natural mobility of sand waves in the proposed Project area. The Proposed Action would not dredge in eelgrass beds or hard-bottom habitats. Overall, the impacts on benthic resources from this IPF would be **minor**.	The Proposed Action could dredge up to 69 acres (0.3 km^2) of seafloor beyond the area affected by cable emplacement, likely leading to short-term **minor** impacts on benthic resources. Ongoing activities cause similar impacts but with a much larger extent. Future offshore wind activities other than the Proposed Action could also cause similar impacts over an area that would likely be on the order of 3 times more than under the Proposed Action. Cumulative impacts of this IPF on benthic resources associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are likely to be widespread and **minor**.
Sediment deposition and burial	Ongoing sediment dredging for navigation purposes results in fine sediment deposition. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local, limited to the emplacement corridor. Sediment deposition could have adverse impacts on some benthic resources, especially eggs and larvae, including smothering and loss of fitness. Impacts may vary based on season/time of year. The Town of Barnstable and Barnstable County typically undertake 10 to 20 dredging projects per year. Where dredged materials are disposed, benthic resources are smothered. However, such areas are typically recolonized naturally in the short term. Most sediment dredging projects have time-of-year restrictions to minimize impacts on benthic resources. Most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area.	The USACE and/or private ports may undertake dredging projects periodically. Where dredged materials are disposed, benthic resources are buried. However, such areas are typically recolonized naturally in the short term. Most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area.	Cable emplacement/ maintenance activities in or near the geographic analysis area during construction or maintenance of future offshore wind projects could cause sediment suspension for 1 to 6 hours at a time. Assuming the extent of such impacts is proportional to the length of cable installed, such impacts from future offshore wind activities would likely be on the order of 3 times more than under the Proposed Action alone. Increased sediment deposition may occur during multiple years. The area with a cumulatively greater sediment deposition from simultaneous or sequential activities would be limited, as most lightly sedimented areas would recover naturally in the short term. If any dredging occurs in the geographic analysis area, dredged material disposal during construction would cause temporary, localized turbidity increases and long-term sedimentation or burial of benthic organisms at the immediate disposal site. The impacts of burial would likely be short-term to long-term.	See Table 3.4-1 on finfish, invertebrates, and EFH. Because most lightly sedimented areas would recover naturally, and most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area, impacts on benthic resources would be **minor**.	The Proposed Action would cause sediment deposition on up to 2,594 acres (10.5 km^2), which would result in **minor** impacts. Ongoing activities would cause similar impacts over an unknown extent. Future offshore wind activities (other than the Proposed Action) would also cause similar impacts over an area that is unknown but would likely be on the order of 3 times more than under the Proposed Action alone. The incremental impact of the Proposed Action with respect to this IPF would be additive with the impact(s) of other offshore wind activities within the geographic analysis area. Cumulative impacts of this IPF on benthic resources associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be short-term to long-term and **minor**.
Climate change: Ocean acidification	Ongoing CO_2 emissions causing ocean acidification may contribute to reduced growth or the decline of benthic invertebrates that have calcareous shells, as well as reefs and other habitats formed by shells.	No future activities were identified within the geographic analysis area other than ongoing activities.	Impacts are practically the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are practically the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to the reduced growth or decline of benthic invertebrates that have calcareous shells. Because this sub-IPF is a global phenomenon, impacts on benthic resources through this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change. The intensity of impacts resulting from climate change are uncertain, but are anticipated to be **minor** to **moderate**.
Climate change: Warming and sea level rise, altered habitat/ecology	Climate change, influenced in part by ongoing greenhouse gas emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the distributions of benthic species and altering ecological relationships, likely causing permanent changes of unknown intensity gradually over the next 30 years.	See above.	See above.	See above.	See above.
Climate change: Warming and sea level rise, altered migration patterns	See above.	See above.	See above.	See above.	See above.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Climate change: Warming and sea level rise, disease frequency	Climate change, influenced in part by ongoing greenhouse gas emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the frequencies of various diseases of benthic species, and likely causing permanent changes of unknown intensity over the next 30 years.	See above.	See above.	See above.	See above.

BMP = best management practice; BOEM = Bureau of Ocean Energy Management; CO_2 = carbon dioxide; COP = Construction and Operations Plan; EFH = Essential Fish Habitat; EIS = Environmental Impact Statement; EMF = electromagnetic field; ESP = electrical service platform; G&G = Geological and Geophysical; hazmat = hazardous materials; IPF = impact-producing factors; km^2 = square kilometers; m^2 = square meter; met = meteorological; NA = not applicable; NOAA = National Oceanic and Atmospheric Administration; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor(s); USACE = U.S. Army Corps of Engineers; USEPA = U.S. Environmental Protection Agency; WTG = wind turbine generator

Table 3.4-1: Summary of Activities and the Associated Impact-Producing Factors for Finfish, Invertebrates, and Essential Fish Habitat

Baseline Conditions: The geographic analysis area for finfish, invertebrates, and EFH consists of the Northeast U.S. Continental Shelf ecosystem. This ecosystem has a very diverse and abundant fish assemblage that can be generally categorized according to life habitats or preferred habitat associations (e.g., pelagic [inhabit the water column], demersal [bottom feeders], resident, and high migratory species). Many of these same species are federally managed species, meaning they have a designated EFH. Some species of commercial importance include Atlantic cod (*Gadus morhua*), flounders, skates, black sea bass (*Centropristis striata*), haddock (*Melanogrammus aeglefinus)*, hakes, monkfish, bay scallops (*Argopecten irradians*), Atlantic sea scallops (*Placopecten magellanicus*), blue mussels (*Mytilus edulis)*, ocean quahogs (*Arctica islandica*), soft shell clams (*Mya arenaria*), whelks, horseshoe crabs, longfin squid (*Doryteuthis pealeii*), and shortfin squid (*Illex illecebrosus*), among others. Many species vary in abundance and distribution across seasons. There are also finfish and invertebrates listed under the Endangered Species Act, although only four of those species (Atlantic sturgeon [*Acipenser oxyrinchus oxyrinchus*], shortnose sturgeon [*Acipenser brevirostrum*], Atlantic salmon [*Salmo salar*], and giant manta [*Manta birostris*]) are likely to occur in the region surrounding the proposed Project.

In the early 2000s, the majority of commercially exploited stocks in this ecosystem were categorized as overfished. A 2015 assessment of 20 groundfish species in the Southern New England sub-region indicates that while the number of overfished stocks has generally decreased, depletion continues for certain stocks (NEFSC 2015). In particular, winter flounder (*Pseudopleuronectes americanus*), yellowtail flounder (*Limanda ferruginea*), and wolffish (*Anarhichas lupus*) remain overfished (NEFSC 2015). According to a more recent assessment, in the New England and Mid-Atlantic regions, 16 fish stocks are in an overfished condition and 7 are currently subject to overfishing (NOAA 2019b). Lobster catches in southern New England have declined sharply since the late 1990s. Other species have increased in commercial importance, including Jonah crab (*Cancer borealis*) and whelks, known in some places as conch. Striped bass (*Morone saxatilis*), once depleted regionally due to overfishing in the early 1980s, are now important regional recreational and commercial fisheries, with 3 million pounds harvested in 2016 (Nelson 2017). The understanding and rebuilding of finfish and invertebrate stocks are complicated by variables such as long-term shifts occurring at the base of the food web (Perretti et al. 2017) and warming ocean temperatures (Hare et al. 2016). Regional water temperatures that increasingly exceed the thermal stress threshold (20°C) may affect the recovery of the American lobster (*Homarus americanus*) stock (ASMFC 2015).

In addition to harvest, finfish, invertebrates, and EFH are subject to pressures from ongoing activities. Water quality impacts from onshore and offshore activities affect nearshore habitats and food webs. Commercial fishing using bottom trawls and dredge-fishing methods regularly disturbs seafloor habitat. Their impacts are similar in nature but much greater in extent (spatially and temporally) than those caused by other bottom-directed IPFs such as pipeline trenching or submarine cable emplacement that create a relatively narrow trench and backfill in the same operation. Commercial fishing and recreational fishing using other methods results in mortality of finfish and invertebrates through harvest and bycatch. See Section 3.11 for details. Commercial and recreational fishing gear is periodically lost, but they can continue to capture or otherwise harm finfish and invertebrates. The lost gear, moved by currents, creates small, localized, short-term impacts. Dredging for navigation, marine minerals extraction, and/or military uses disturbs swaths of seafloor habitat. Their impacts are similar in nature but much greater in extent (spatially and temporally) than those caused by other bottom-directed IPFs such as pipeline trenching or submarine cable emplacement that create a relatively narrow trench and backfill in the same operation.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/ hazmat	See Table A-8 in Appendix A for a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Impacts, including mortality, decreased fitness, and contamination of habitat, are localized and temporary, and rarely affect populations.	See Table A-8 in Appendix A for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. Impacts are unlikely to affect populations.	See Table A-8 in Appendix A for details. Using the assumptions in Appendix A, there would be a low risk of a release from any of 2,021 WTGs and 45 ESPs, with a total of approximately 13.1 million gallons (49.6 million liters) of fuel/fluids/hazmat contained in all offshore wind facilities. According to BOEM's 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 likelihood of a spill occurring from multiple WTGs and ESPs at the same time is very low and, therefore, the potential impact from a spill larger than 2,000 gallons (7,571 liters) are largely discountable. Based on these rates, the additional impact of releases from future offshore wind facilities, the risk of which would primarily exist during construction, but also during operations and decommissioning, would fall within the range of ongoing activities.	See Table A-8 in Appendix A for a quantitative analysis of these risks. The Proposed Action would increase the risk of releases, which would have temporary localized impacts including mortality and decreased fitness. The low likelihood and small size of potential releases, along with the measures in place to clean them up, indicate that these impacts would likely be **negligible**.	The impacts on finfish, invertebrates, and EFH from this sub-IPF under the Proposed Action would include an increased potential for a release that would have localized and temporary impacts, including mortality and decreased fitness, likely resulting in **negligible** impacts. The impacts from ongoing activities and future non-offshore wind activities stem from the increased potential for releases over the next 30 years due to increasing vessel traffic and ongoing releases, which are frequent/chronic. Future offshore wind activities would contribute to an increased risk of spills and impacts on this resource, including mortality, decreased fitness, and increased disease occurrence due to fuel/fluid/hazmat exposure. The contribution from future offshore wind and the Proposed Action would be a low percentage of the overall spill risk from ongoing activities. Cumulatively, the impacts on finfish, invertebrates, and EFH (mortality, decreased fitness, disease) from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be localized, temporary, and **negligible** to **minor** due to the likely limited extent and duration of a release, described in detail in the Draft EIS Section 3.2.2.3. See Table A-8 in Appendix A for additional details.
Accidental releases: Invasive species	Invasive species are periodically released accidentally during ongoing activities, including the discharge of ballast water and bilge water from marine vessels. The impacts on finfish, invertebrates, and EFH depend on many factors, but can be widespread and permanent.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.	Increasing vessel traffic related to the offshore wind industry would increase the risk of accidental releases of invasive species, primarily during construction. The impacts on finfish, invertebrates, and EFH depend on many factors, but could be widespread and permanent.	The increased vessel traffic associated with the Proposed Action, especially traffic from foreign ports, would increase the risk of accidental releases of invasive species, primarily during construction. The impacts on finfish, invertebrates, and EFH depend on many factors, but could be widespread and permanent. The increase in risk of accidental releases of invasive species attributable to the Proposed Action would be **negligible**.	The Proposed Action would cause a **negligible** increase in the risk of accidental releases of invasive species, primarily during construction. Ongoing activities currently present a risk of accidental releases. Offshore wind activities other than the Proposed Action would increase this risk. Cumulatively, the risk of impacts on finfish, invertebrates, and EFH due to accidental releases of invasive species associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities could qualify as **major**, and most of this risk comes from ongoing activities, as it is generally related to the volume of vessel traffic.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Anchoring	Vessel anchoring related to ongoing military use, and survey, commercial, and recreational activities continues to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. Impacts on finfish, invertebrates, and EFH are greatest for sensitive EFH (e.g., eelgrass, hard bottom) and sessile or slow-moving species (e.g., corals, sponges, and sedentary shellfish).	Impacts from anchoring may occur on a semi-regular basis over the next 30 years due to offshore military operations, survey activities, commercial vessel traffic, and/or recreational vessel traffic. These impacts would include increased turbidity levels and potential for direct contact causing mortality of benthic species and, possibly, degradation of sensitive habitats. All impacts would be localized; turbidity would be temporary; impacts from direct contact would be recovered in the short term. Degradation of sensitive habitats such as certain types of hard bottom (e.g., boulder piles), if it occurs, could be long-term.	Using the assumptions in Table A-4 in Appendix A, anchoring could affect up to approximately 276 acres (1.1 km^2). Impacts (turbidity, mortality, degradation of sensitive habitats) would be localized, occurring primarily during construction, but also during operations and decommissioning; turbidity would be temporary, and impacts from direct contact would be recovered in the short term. Degradation of sensitive habitats such as certain types of hard bottom (e.g., boulder piles), if it occurs, could be long-term.	The COP estimated that anchoring would disturb up to 4.4 acres (17,806 m^2). These impacts would primarily occur during construction, but could also occur during operations and decommissioning and would include increased turbidity levels and the potential for direct contact to cause mortality of benthic species. All impacts would be localized; turbidity would be temporary; impacts from direct contact would be recovered in the short term. The Proposed Action would not anchor in eelgrass. The overall impact of anchoring on finfish, invertebrates, and EFH would be **minor**.	Anchoring associated with the Proposed Action would disturb up to 4.4 acres (17,806 m^2), resulting in temporary to short-term **minor** impacts (turbidity, mortality) on finfish, invertebrates, and EFH. Ongoing and future non-offshore wind activities would cause a series of temporary localized impacts. Offshore wind activities, other than the proposed Project, would affect up to 276 acres (1.1 km^2). Cumulatively, anchoring could affect up to 276 acres (1.1 km^2) associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities, although some of this may occur after the resource has recovered from the earlier impact(s), resulting in **minor** cumulative impacts on finfish, invertebrates, and EFH. Degradation of sensitive habitats such as certain types of hard bottom (e.g., boulder piles), if it occurs, could be long-term.
EMF	EMF emanates continuously from installed telecommunication and electrical power transmission cables. Biologically significant impacts on finfish, invertebrates, and EFH have not been documented for AC cables (CSA Ocean Sciences, Inc. and Exponent 2019 and see Thomsen et al. 2015), but behavioral impacts have been documented for benthic species (skates and lobster) near operating DC cables (Hutchinson et al. 2018). The impacts are localized and affect the animals only while they are within the EMF. There is no evidence to indicate that EMF from undersea AC power cables negatively affects commercially and recreationally important fish species within the southern New England area (CSA Ocean Sciences, Inc. and Exponent 2019).	During operation, future new cables would produce EMF. (See cell to the left.) Submarine power cables in the geographic analysis area for this resource are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. (See Section 5.2.7 of BOEM 2007.) EMF of any two sources would not overlap (even for multiple cables within a single OECC). Although the EMF would exist as long as a cable was in operation, impacts, on finfish, invertebrates, and EFH would likely be difficult to detect.	In the expanded cumulative scenario, up to 5,947 miles (9,571 kilometers) of cable would be added in the geographic analysis area for this resource, producing EMF in the immediate vicinity of each cable during operations. (See cells to the left.)	EMFs would emanate from the Proposed Action's AC cables during operation. The shielding and burial depths under the Proposed Action would minimize EMF intensity and extent. Although the EMF would exist as long as a cable was in operation, a study by CSA Ocean Sciences Inc. and Exponent (2019) found that EMF from offshore wind energy projects are not expected to affect commercial and recreational fishes within the southern New England area; therefore, impacts on pelagic species are expected to be **negligible** and impacts on bottom-dwelling species are expected to be **minor**.	EMFs from the Proposed Action are expected to lead to **negligible** to **minor** impacts on finfish, invertebrates, and EFH. Although EMF would emanate from any operating cable related to the Proposed Action, ongoing activities, future non-offshore wind activities, or future offshore wind activities, it does not appear likely that there would be any noticeable individual or cumulative effect on finfish, invertebrates, and EFH. According to CSA Ocean Sciences Inc. and Exponent (2019), EMF from offshore wind energy projects are not expected to affect commercial and recreational fishes within the southern New England area. Overall, the cumulative impacts of EMF on finfish, invertebrates, and EFH associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be **negligible** to **minor**.
Light: Vessels	Marine vessels have an array of lights including navigational lights and deck lights. There is little downward-focused lighting, and therefore only a small fraction of the emitted light enters the water. Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light may also disrupt natural cycles, e.g., spawning, possibly leading to short-term impacts.	See cell to the left. Also see Section 3.13.	In a maximum-case scenario, lights on vessels used for offshore wind construction could be active 24 hours per day during construction. This could attract finfish and invertebrates to construction zones, potentially exposing them to greater harm from other IPFs (e.g., Noise). If there were no nighttime construction, this would not be a factor. Minimal vessel light could also occur during operations and decommissioning.	Vineyard Wind has agreed to avoid nighttime pile driving, and the Proposed Action would allow other nighttime work only on an as-needed basis, in which case the Project would reduce lighting of vessels, minimizing the potential for attracting finfish and invertebrates. These impacts would be highly localized and would exist only as long as the lights were in use. Navigation lights during construction, operations, and decommissioning would be minimal, and are expected to cause a **negligible** impact on finfish, invertebrates, and EFH.	The Proposed Action would cause **negligible** impacts on finfish, invertebrates, and EFH from this sub-IPF. The impacts of ongoing activities and future non-offshore wind activities (attraction, behavioral disruption) are highly localized, temporary to short-term, and greater than the expected impacts of future offshore wind activities. Future offshore wind activities would likely result in the same type of impacts, but with a smaller spatial and temporal extent. Overall, the cumulative impacts of this sub-IPF on finfish, invertebrates, and EFH associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be limited to **negligible** short-term and highly localized attraction and potential disruption of spawning cycles.
Light: Structures	Offshore buoys and towers emit light, and onshore structures, including buildings and ports, emit a great deal more on an ongoing basis. Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light may also disrupt natural cycles, e.g., spawning, possibly leading to short-term impacts. Light from structures is widespread and permanent near the coast, but minimal offshore.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.	Up to 2,021 WTGs and 45 ESPs would have lights 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 on the OCS. Because there would be no downward-focused lighting, only a small fraction of the emitted light would enter the water. Therefore, no impacts on finfish, invertebrates, and EFH are expected.	Up to 100 turbines and 2 ESPs would have aviation hazard and/or navigation lights during the 30-year operational phase of the Proposed Action. There would be no downward-focused lighting, and therefore only a small fraction of the emitted light would enter the water, causing no impact on finfish, invertebrates, and EFH.	The Proposed Action is not expected to cause impacts on finfish, invertebrates, and EFH through this sub-IPF. The impacts from ongoing activities and future non-offshore wind activities are widespread and permanent near the coast, but minimal offshore. Future offshore wind activities would be unlikely to cause impacts on finfish, invertebrates, and EFH through this sub-IPF. No cumulative impacts of this sub-IPF on finfish, invertebrates, and EFH can be attributed to the Proposed Action, although ongoing and future non-offshore wind activities are expected to cause permanent impacts, primarily driven by light from onshore structures.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances are local, limited to the cable corridor. Refer to BOEM (2019b) for details. New cables are infrequently added near shore. Cable emplacement/maintenance activities disturb, displace, and injure finfish and invertebrates and result in temporary to long-term habitat alterations. The intensity of impacts depends on the time (season) and place (habitat type) where the activities occur. (See also the IPF of Sediment deposition and burial.)	Future new cables would occasionally disturb the seafloor and cause temporary increases in suspended sediment, resulting in local short-term impacts. The FCC has two pending submarine telecommunication cable applications in the North Atlantic. If the cable routes enter the geographic analysis area for this resource, short-term disturbance would be expected. The intensity of impacts would depend on the time (season) and place (habitat type) where the activities would occur.	Assuming similar installation procedures as the proposed Project, the extent of impacts would be limited to approximately 6 feet (2 meters) to either side of each cable and finfish, invertebrates, and most EFH would recover following the disturbance, although some habitats would not fully return to their previous conditions. . Impacts would occur during construction and would involve increased turbidity for 1 to 6 hours at a time. Short-term effects on populations could occur in the immediate vicinity of installation activities. The total area of direct seafloor disturbance is estimated to be up to 8,153 acres (33 km^2). If routes intersect eelgrass or hard-bottom habitats, impacts may be long-term to permanent; otherwise, impacts would be recovered in the short term. (See also the IPF of Sediment deposition and burial.)	The Proposed Action would cause short-term disturbances during construction and possibly during maintenance. The Proposed Action estimated that up to 328 acres (1.3 km^2) of sea floor could be disturbed by cable installation. (See also the IPF of Sediment deposition and burial.) Where cables intersect hard-bottom habitats, impacts may be long-term to permanent. Cable installation would mostly be done by jet or mechanical plow. Overall, these impacts would likely be **moderate**.	The Proposed Action estimated that up to 328 acres (1.3 km^2) of sea floor could be disturbed by cable installation and that up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation, potentially leading to short-term, **moderate** impacts including mortality and reduced fitness, and possibly long-term to permanent **moderate** impacts in hard-bottom habitats. Ongoing and future non-offshore wind activities may cause local short-term impacts. Future offshore wind activities other than the Proposed Action would disturb up to 8,153 acres (33.0 km^2). Cumulatively, impacts (mortality, short-term reductions in fitness) would occur as a result of an estimated 8,153 acres (33.0 km^2) of disturbance associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities, leading to **moderate** cumulative impacts on finfish, invertebrates, and EFH.
Noise: Aircraft	Noise from aircraft reaches the sea surface on a regular basis. However, there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH, as very little of the aircraft noise propagates through the water.	Aircraft noise is likely to continue to increase as commercial air traffic increases. However, there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH.	Offshore wind projects may use aircraft for crew transport during maintenance and/or construction over the next 30 years. However, there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH.	Vineyard Wind may use aircraft for crew transport during maintenance over the life of the Project. However, there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH.	There is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH in the geographic analysis area for this resource.
Noise: Onshore/offshore construction	Noise from construction occurs frequently in near shores of populated areas in New England and the mid-Atlantic but infrequently offshore. The intensity and extent of noise from construction is difficult to generalize, but impacts are local and temporary. See also sub-IPF for Noise: Pile driving.	Noise from construction near shores is expected to gradually increase in line with human population growth along the coast of the geographic analysis area for this resource.	In the expanded cumulative scenario, construction of 2,066 offshore structures would create noise and temporarily impact finfish, invertebrates, and EFH. The greatest impact of noise is likely to be caused by pile driving (see below). Such noise would be intermittent and would occur over an assumed 6- to 10-year period.	Construction of up to 102 offshore structures would create noise and temporarily impact finfish, invertebrates, and EFH. The greatest impact of noise is likely to be caused by pile driving (see below).	The majority of impacts from construction noise is likely to be related to pile driving (see below). All other sources of construction noise would likely not lead to noticeable impacts on finfish, invertebrates, and EFH.
Noise: G&G	Ongoing site characterization surveys and scientific surveys produce noise around sites of investigation. These activities can disturb finfish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes. The extent depends on equipment used, noise levels, and local acoustic conditions.	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 30 years. Seismic surveys used in oil and gas exploration create high-intensity impulsive noise to penetrate deep into the seabed, potentially resulting in injury or mortality to finfish and invertebrates in a small area around each sound source and short-term stress and behavioral changes to individuals over a greater area. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves more similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize, but are likely local and temporary.	Site characterization surveys for offshore wind facilities would create intermittent noise around sites of investigation over a 2- to 10-year period. These activities can disturb finfish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes.	Noise from G&G surveys during inspection and/or monitoring of cable routes may occur during construction and operations. G&G noise resulting from cable route surveys can disturb finfish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes. Impacts on finfish, invertebrates, and EFH are anticipated to be temporary and **negligible**.	G&G survey noise from the Proposed Action may result in temporary **negligible** impacts (behavioral effects) on finfish, invertebrates, and EFH along the cable routes during inspection. Ongoing and future non-offshore wind impacts may result in similar types of impacts to the Proposed Action over an unknown extent, and possibly could also result in injury or mortality during seismic surveys. Future offshore wind other than the proposed Project would likely have similar impacts as the Proposed Action but across a much greater area. Cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be approximately equal to the sum of all of these impacts and would likely qualify as **minor**.
Noise: O&M	Some finfish and invertebrates may be able to hear the continuous underwater noise of operational WTGs. As measured at the Block Island Wind Farm, this low frequency noise barley exceeds ambient levels at 164 feet (50 meters) from the WTG base. Based on the results of Thomsen et al. (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. Noise is also created by operations and maintenance of marine minerals extraction and commercial fisheries, each of which has small local impacts.	New or expanded marine minerals extraction and commercial fisheries may intermittently increase noise during their operations and maintenance over the next 30 years. Impacts would likely be small and local.	While continuous 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 adversely affect finfish, invertebrates, and EFH (English et al. 2017).	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 adversely affect finfish, invertebrates, and EFH (English et al. 2017).	There does not appear to be evidence that noise related to operations and maintenance of offshore wind energy facilities would negatively affect finfish, invertebrates, and EFH. The Proposed Action is not expected to cause impacts on finfish, invertebrates, and EFH through this sub-IPF. Ongoing and future non-offshore wind activities may result in small local impacts on finfish and invertebrates, such as behavioral effects and/or displacement. Future offshore wind other than the proposed Project is not expected to cause impacts on finfish, invertebrates, and EFH through this sub-IPF. No cumulative impacts of this sub-IPF on finfish, invertebrates, and EFH can be attributed to the Proposed Action, although ongoing and future activities may cause small local impacts.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to finfish and invertebrates in a small area around each pile, and can cause short-term stress and behavioral changes to individuals over a greater area. Eggs, embryos, and larvae of finfish and invertebrates could also experience developmental abnormalities or mortality resulting from this noise, although thresholds of exposure are not known (Weilgart 2018, Hawkins and Popper 2017). Potentially injurious noise could also be considered as rendering EFH temporarily unavailable or unsuitable for the duration of the noise. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.	Noise from pile driving would occur during installation of foundations for offshore structures for 4 to 6 hours at a time over a 6- to 10-year period, likely causing injury and/or mortality to finfish and invertebrates in a small radius around each pile and short-term stress and behavioral changes to individuals over a greater area. Based on estimates from the COP, if all 2,066 foundations in the expanded cumulative scenario are summed, the risk of injury or mortality is expected to occur over approximately 12,102 acres (48 km^2). The impact on finfish and invertebrates would depend on the time of year it occurs; the impact could be greater if the noise occurs in spawning habitat during a spawning period. Noise from pile driving could affect the same populations or individuals multiple times in 1 year or in sequential years. The affected spaces would likely be recolonized in the short term.	Noise from pile driving would occur during installation of foundations for 4 to 6 hours at a time. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to finfish and invertebrates in a small area around each pile, and can cause short-term stress and behavioral changes to individuals over a greater area, particularly for species that use sound to coordinate spawning activity, such as cod and squid, possibly leading to additional impacts on reproduction. The estimated extent of behavioral effects is up to 5.7 miles (8 kilometers) around each pile, and the radius for injury or mortality is estimated to extend 285 feet (87 meters) from each foundation, totaling approximately 503 acres (2 km^2). The affected areas would likely be recolonized in the short term, and the overall impact on finfish, invertebrates, and EFH would be **minor**.	The Proposed Action is expected to cause short-term, **minor** impacts, with potential injury or mortality occurring across approximately 503 acres (2 km^2) of sea surface and behavioral changes occurring over a greater area. Ongoing and future non-offshore wind activities may have similar effects, perhaps with a smaller extent. Future offshore wind activities other than the proposed Project could cause potential injury or mortality across approximately 12,102 acres (48.0 km^2) and behavioral changes over a greater area. The cumulative area affected by pile-driving noise would be the same regardless of whether the proposed Project COP is approved, approved with modifications, or disapproved, and is expected to include potential injury or mortality across approximately 12,102 acres (48.0 km^2) and behavioral changes over a greater area. The cumulative impact of pile-driving noise on finfish, invertebrates, and EFH associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely qualify as **moderate**. If multiple piles are driven in any single day, areas with enough noise to generate behavioral changes may overlap. Over a longer time scale, noise from pile driving could affect the same populations or individuals multiple times in 1 year or in sequential years; it is currently unknown whether it would be less impactful to drive many piles sequentially or concurrently.
Noise: Cable laying/ trenching	Infrequent trenching activities for pipeline and cable laying, as well as other cable burial methods, emit noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	New or expanded submarine cables and pipelines are likely to occur in the geographic analysis area for this resource. These disturbances would be infrequent over the next 30 years, temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	Noise from trenching/burial of inter-array and export cables would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension. This noise would be intermittent and would occur over a 6- to 10-year period.	Noise from trenching of export cables may occur during construction, although most of the export cables would be installed using a trenchless jet plowing method. The jet plowing method also creates noise. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension. This noise would likely have **negligible** impacts on finfish, invertebrates, and EFH.	The Proposed Action would likely have **negligible** impacts on finfish, invertebrates, and EFH through trenching/cable burial noise. The impact on finfish, invertebrates, and EFH of this type of noise associated with ongoing activities, future non-offshore wind activities, and future offshore wind activities is discountable compared to the impacts of the physical disturbance and sediment suspension. The cumulative impact of this noise on finfish, invertebrates, and EFH associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be **negligible**.
Noise: Vessels	See Section 3.13. While ongoing vessel noise may have some effect on behavior, it is likely limited to brief startle and temporary stress responses. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels.	See Section 3.13.	Pelagic species may temporarily avoid vessel noise, which would occur primarily during construction but also during operations and decommissioning, but in general, the noise would not be loud enough for long enough to induce injury (MMS 2009).	Pelagic and demersal species may temporarily avoid vessel noise caused by the proposed Project construction, operations, and decommissioning activities, but in general, the noise would not be loud enough for long enough to induce injury or death (MMS 2009). Analysis of vessel noise related to the Cape Wind Energy Project found that noise levels from construction vessels at 10 feet (3 meters) were loud enough to induce avoidance, but not physically harm finfish and/or invertebrates (MMS 2009). Overall, impacts of this sub-IPF would likely be temporary and **minor**.	Vessel noise from the Proposed Action is anticipated to cause **minor** temporary local impacts on finfish and invertebrates. Vessel noise from ongoing activities and future non-offshore wind activities is also expected to cause small, temporary, local impacts on finfish and invertebrates. Vessel noise from future offshore wind activities other than the proposed Project is also expected to cause small, temporary, local impacts on finfish and invertebrates. Cumulative impacts, equal to the sum of all of these impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities, are anticipated to constitute **minor** impacts on finfish, invertebrates, and EFH in the geographic analysis area for this resource.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance, including dredging. Port utilization is expected to increase over the next 30 years.	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. Certain types of vessel traffic have increased recently (e.g. ferry use and cruise industry) and may continue to increase in the foreseeable future. In addition, the general trend along the coast from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase may require port modifications, leading to local impacts. Future channel deepening activities will likely be undertaken. Existing ports have already affected finfish, invertebrates, and EFH, and future port projects would implement BMPs to minimize impacts. Although the degree of impacts on EFH would likely be undetectable outside the immediate vicinity of the ports, adverse impacts on EFH for certain species and/or life stages may lead to impacts on	At least two projects are contemplating port expansion/modification in Vineyard Haven and in Montauk. It is likely that other ports would be upgraded along the east coast, and some of this may be attributable to supporting the offshore wind industry. This would increase the total amount of disturbed habitat, possibly including EFH. Intermittent increases in port utilization due to other offshore wind energy projects would lead to increased vessel traffic over an assumed 6- to 10-year period. Existing ports have already affected finfish, invertebrates, and EFH, and future port projects would implement BMPs to minimize impacts. Although the degree of impacts on EFH would likely be undetectable outside the immediate vicinity of the ports, adverse impacts on EFH for certain species and/or life stages may lead to impacts on finfish and invertebrates beyond the vicinity of the port.	The Proposed Action is not anticipated to cause any port expansion or otherwise affect finfish, invertebrates, and EFH near ports.	The Proposed Action is not anticipated to cause any port expansion or otherwise affect finfish, invertebrates, and EFH near ports. Ongoing and future non-offshore wind activities are expected to cause impacts through this sub-IPF on finfish, invertebrates, and EFH that are less than noticeable. Future offshore wind activities other than the proposed Project are expected to cause impacts through this sub-IPF on finfish, invertebrates, and EFH that are less than noticeable. No cumulative impacts of this sub-IPF on finfish, invertebrates, and EFH can be attributed to the Proposed Action, although ongoing and future activities are expected to result in less than noticeable impacts on finfish, invertebrates, and EFH.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
		finfish and invertebrates beyond the vicinity of the port.			
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb habitats and potentially harm individuals, creating small, localized, short-term impacts.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.	Development of the projects in the expanded cumulative scenario would install more buoys, met towers, foundations, and hard protection. Approximately 1,221 acres (4.9 km^2) of hard protection atop cables, 1,723 acres (7.0 km^2) of foundation scour protection, and the vertical surfaces of up to 2,066 new foundations would increase the risk of gear loss/damage by entanglement and the ensuing impacts on finfish, invertebrates, and EFH. BOEM anticipates that structures would be added intermittently over an assumed 6- to 10-year period and that they would remain until decommissioning of each facility is complete. Rock used for cable/scour protection may remain permanently. The intermittent impacts at any one location would likely be difficult to detect, short-term, and localized, although the risk of occurrence would persist as long as the structures remain.	The Proposed Action would add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations would remain for the life of the Project, and scour/cable protection would likely remain permanently. This would increase the risk of gear loss/damage by entanglement and the ensuing impacts on finfish, invertebrates, and EFH. Impacts at any one location would likely be localized, short-term, and **negligible**, although the risk of occurrence would persist as long as the structures remain.	The risk of impacts from this sub-IPF is proportional to the amount of structure present. The Proposed Action would add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection, resulting in **negligible** impacts (injury) on finfish, invertebrates, and EFH through this sub-IPF. Ongoing entanglement and gear loss/damage at existing structures also periodically results in short-term, localized impacts. Future offshore wind activities other than the proposed Project would add approximately 1,221 acres (4.9 km^2) of hard protection atop cables, 1,723 acres (7.0 km^2) of foundation scour protection, and the vertical surfaces of up to 2,066 new foundations. Cumulatively, up to 2,066 foundations, 1,221 acres (4.9 km^2) of hard protection atop cables, and 1,723 acres (7.0 km^2) of foundation scour protection would increase the risk of highly localized, periodic, short-term impacts (e.g., habitat disturbance, harm to individuals); the cumulative impact on finfish, invertebrates, and EFH through this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would likely be **negligible**.
Presence of structures: Hydrodynamic disturbance	Manmade structures, especially tall vertical structures such as foundations for towers of various purposes, continuously alter local water flow at a fine scale. Water flow typically returns to background levels within a relatively short distance from the structure. Therefore, impacts on finfish, invertebrates, and EFH are typically undetectable. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood. New structures are periodically added.	Tall vertical structures can increase seabed scour and sediment suspension. Impacts would likely be highly localized and difficult to detect. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood.	See above for quantification. New structures would disturb hydrodynamics as long as the structures remain. Impacts would likely be highly localized and difficult to detect. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood.	See above for quantification. An alteration of local water currents caused by the presence of WTG and ESP foundations during the life of the Project could affect the dispersal of planktonic stages of organisms. A modeling study by Chen et al. (2016) found that WTGs in the region would not have a significant influence on southward larval transport, although foundation placement could either increase or decrease larval dispersion and speed, depending on initial location; however, the models never found the foundations to trap or block larvae from settling in habitat previously occupied. The same study found that on the scale of a single turbine in a current-only regime, mean flows return to within 5 percent of background levels by approximately 8.3 times the pile diameter away from the pile. In a combined current and wave regime, flow returned to background levels within 3.5 times the pile diameter. A separate study by Cazenave et al. (2016) found that downstream effects have a length scale of up to 50 times the pile diameter, or in the case of a 33.8-foot (10.3-meter) diameter pile, within 163 to 1,148 feet (20 to 350 meters) from the pile. A shelf-scale model used by Cazenave et al. (2016) found that disruptions could reach as far as approximately 0.5 nautical mile (1 kilometer) downstream of a monopile foundation. COP Appendix III-K discusses local hydrodynamic forces. The WTG and ESP foundations result in localized alterations of water currents, but the low current speeds at the seabed in the lease area and minimal seabed mobility lower scour concerns. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood. Overall, BOEM anticipates the Proposed Action would cause a **negligible** impact on finish, invertebrates, and EFH through this sub-IPF.	See above for quantification. The Proposed Action is expected to cause localized disturbances, resulting in **negligible** impact on finfish, invertebrates, and EFH. Existing structures and future non-offshore wind structures also cause localized disturbances, resulting in little to no impact on finfish, invertebrates, and EFH. Other offshore wind structures also would cause localized disturbances, resulting in little to no impact on finfish, invertebrates, and EFH. Cumulatively, this sub-IPF is anticipated to cause permanent, highly localized changes that have **negligible** impact on finfish, invertebrates, and EFH.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. Structure-oriented fishes are attracted to these locations. These impacts are local and often permanent. Fish aggregation may be considered adverse, beneficial, or neutral.	New cables, installed incrementally in the geographic analysis area for this resource over the next 20 to 30 years, would likely require hard protection atop portions of the route (see the New cable emplacement/ maintenance IPF). Any new towers, buoys, or piers would also create uncommon relief in a mostly sandy seascape. Structure-oriented fishes could be attracted to these locations. Abundance of certain fishes may increase. These impacts are local and may be permanent.	See above for quantification. New structures would attract structure-oriented fishes as long as the structures remain. Abundance of certain fishes may increase (Claisse et al. 2014, Smith et al. 2016). There may also be an increase in recreational fishing, both personal and for-hire. These impacts are expected to be local and may be permanent.	See above for quantification. Foundations would remain for the life of the Project, and scour/cable protection would likely remain permanently. Structure-oriented fishes could be attracted to these locations. Abundance of certain fishes may increase. These impacts are expected to be local, **moderate**, and may be permanent. Fish aggregation may be considered adverse, beneficial, or neutral.	See above for quantification. The Proposed Action is expected to cause local, **moderate** impacts on finfish and invertebrates through this sub-IPF. Existing structures and future non-offshore wind structures expected to cause localized impacts on finfish and invertebrates through this sub-IPF. Offshore wind structures other than those associated with the proposed Project are also expected to cause local impacts on finfish and invertebrates through this sub-IPF. Cumulatively, this sub-IPF is anticipated to cause many local impacts that may be short-term to permanent, overall resulting in **moderate** cumulative impacts on finfish, invertebrates, and EFH associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities; BOEM does not anticipate that this sub-IPF would result in considerable changes in fish distributions across the geographic analysis area for this resource.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Habitat conversion	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. A large portion is homogeneous sandy seascape but there is some other hard and/or complex habitat. Structure-oriented species thus benefit on a constant basis; however, the diversity may decline over time as early colonizers are replaced by successional communities dominated by blue mussels and anemones (Degraer et al. 2019 [Chapter 7]). New surfaces can also be colonized by invasive species (e.g., certain tunicate species) found in hard-bottom habitats on Georges Bank (Frady and Mecray 2004). Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat.	New cable, installed incrementally in the analysis area over the next 20 to 30 years, would likely require hard protection atop portions of the route (see New cable emplacement/ maintenance). Any new towers, buoys, or piers would also create uncommon relief in a mostly sandy seascape. Structure-oriented species would benefit (Claisse et al. 2014, Smith et al. 2016); however, the diversity may decline over time as early colonizers are replaced by successional communities dominated by blue mussels and anemones (Degraer et al. 2019 [Chapter 7]). Soft bottom is the dominant habitat type from Cape Hatteras to the Gulf of Maine (over 60 million acres [242,811 km²]), and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010).	See above for quantification and timing of impacts. See cells to the left for the nature of impacts. The presence of many distinct areas of hard structure could also increase connectivity between geographically distant populations (Folpp et al. 2011, Mora et al. 2003), as the structures may provide patches of attractive habitat, helping structure-oriented species traverse the mostly sandy OCS.	The Proposed Action is expected to add up to 102 foundations and 151 acres (0.6 km²) of scour/cable protection. Foundations would remain for the life of the Project, and scour/cable protection would likely remain permanently. All of this would provide new hard-structure habitat and would replace existing soft-bottom and hard-bottom habitat. Structure-oriented species would benefit; however, the diversity may decline over time as early colonizers are replaced by successional communities dominated by blue mussels and anemones (Degraer et al. 2019 [Chapter 7]). These impacts would be both beneficial and adverse, likely resulting in a net benefit expected to be local, permanent, and **moderate**.	See above for quantification. The Proposed Action is expected to cause localized impacts that would be both beneficial and adverse, likely resulting in a net benefit expected to be **moderate**. Existing structures and future non-offshore wind structures are also expected to cause localized impacts on finfish and invertebrates through this sub-IPF. Offshore wind structures other than those associated with the proposed Project are also expected to cause localized impacts on finfish and invertebrates through this sub-IPF. Cumulatively, this sub-IPF is anticipated to cause many permanent local impacts on finfish, invertebrates, and EFH that may be beneficial. Overall, the cumulative impacts of this sub-IPF on finfish, invertebrates, and EFH associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are anticipated to be **moderate beneficial** impacts.
Presence of structures: Migration disturbances	Human structures in the marine environment, e.g., shipwrecks, artificial reefs, and oil platforms, can attract finfish and invertebrates that approach the structures during their migrations. This could slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure is (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). There is no evidence to suggest that structures pose a barrier to migratory animals.	The infrequent installation of future new structures in the marine environment over the next 30 years may attract finfish and invertebrates that approach the structures during their migrations. This could tend to slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded.	See above for quantification. New structures would be added intermittently over an assumed 6- to 10-year period and could tend to slow migration of some migratory species. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure would be (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded.	See above for quantification. Foundations would remain for the life of the Project, and scour/cable protection would likely remain permanently This could tend to slow migration. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure would be (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded. Therefore, this impact is anticipated to be **negligible**.	See above for quantification. The Proposed Action is expected to present a **negligible** risk of slowing migrations of finfish and invertebrates. Existing structures and future non-offshore wind structures are also expected to present a risk of slowing migrations of finfish and invertebrates. Offshore wind structures other than those associated with the proposed Project are also expected to present a risk of slowing migrations of finfish and invertebrates. Cumulatively, the presence of many distinct structures associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities could increase the time required for migrations, resulting in a **minor** cumulative impact.
Presence of structures: Transmission cable infrastructure	See other sub-IPFs within the Presence of structures IPF. See Table 3.2-1 on Coastal Habitats.	See other sub-IPFs within the Presence of structures IPF. See Table 3.2-1 on Coastal Habitats.	See other sub-IPFs within the Presence of structures IPF. See Table 3.2-1 on Coastal Habitats.	See other sub-IPFs within the Presence of structures IPF. See Table 3.2-1 on Coastal Habitats.	See other sub-IPFs within the Presence of structures IPF. See Table 3.2-1 on Coastal Habitats.
Regulated fishing effort	Regulated fishing effort results in the removal of a substantial amount of the annually produced biomass of commercially regulated finfish and invertebrates and can also influence bycatch of non-regulated species. Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by states, municipalities, and/or NOAA, depending on jurisdiction, affect finfish, invertebrates, and EFH by modifying the nature, distribution and intensity of fishing-related impacts, including those that disturb the seafloor (trawling, dredge fishing).	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.	Offshore wind development could indirectly influence this IPF (Section 3.11) by indirectly 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.	The Proposed Action could indirectly influence this IPF (Section 3.11), possibly indirectly influencing the nature, distribution, and intensity of fishing-related impacts on finfish, invertebrates, and EFH.	Regulated fishing effort can affect finfish, invertebrates, and EFH by modifying the nature, distribution and intensity of fishing-related impacts (mortality, bottom disturbance). See Section 3.11 for the cumulative contribution of ongoing, future non-offshore wind, future offshore wind other than the Proposed Action, and the Proposed Action on regulated fishing effort. 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 likely qualify as **moderate**.
Seabed profile alterations	Ongoing sediment dredging for navigation purposes results in localized short-term impacts (habitat alteration, change in complexity) on finfish, invertebrates, and EFH through this IPF. For example, the Town of Barnstable and Barnstable County typically undertake 10 to 20 dredging projects per year, and other municipalities, states, private entities, and the USACE undertake many more. Dredging is most likely in sand wave areas where typical jet plowing is insufficient to meet target cable burial depth. Sand waves that are dredged would likely be redeposited in like-sediment areas. Any particular sand wave may not recover to the same height and width as pre-disturbance; however, the habitat function would largely recover post-disturbance. Therefore, seabed profile alterations, while locally intense, have little	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.	Dredging used in the course of cable installation can cause localized short-term impacts (habitat alteration, change in complexity) through seabed profile alterations, as well as through sediment deposition (see below). Assuming the extent of such impacts is proportional to the length of cable installed, such impacts from future offshore wind activities would likely be on the order of 20 times more than under the Proposed Action alone. Dredging is most likely in sand wave areas where typical jet plowing is insufficient to meet target cable burial depth. Sand waves that are dredged would likely be redeposited in like-sediment areas. Any particular sand wave may not recover to the same height and width as pre-disturbance; however, the habitat function would largely recover post-disturbance. Therefore, seabed profile alterations, while locally intense, have	During construction, the Proposed Action could dredge up to 69 acres (0.3 km²) of seafloor beyond the area affected by cable emplacement, potentially leading to short-term impacts including habitat alteration and change in complexity. The impacts would likely be short-term, considering the natural mobility of sand waves in the proposed Project area. The Proposed Action would not dredge in eelgrass beds or hard-bottom habitats. Overall, the impacts on finfish, invertebrates, and EFH from this IPF would be **minor**.	The Proposed Action could dredge up to 69 acres (0.3 km²) of seafloor beyond the area affected by cable emplacement, likely leading to short-term, **minor** impacts on finfish, invertebrates, and EFH. Ongoing activities cause similar impacts but with a much larger extent. Future offshore wind activities other than the Proposed Action could also cause similar impacts over an area that would likely be on the order of 20 times more than under the Proposed Action. Cumulative impacts of this IPF on finfish, invertebrates, and EFH associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are likely to be widespread and **minor**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	impact on finfish, invertebrates, and EFH on a regional (Cape Hatteras to Gulf of Maine) scale.		little impact on finfish, invertebrates, and EFH on a regional (Cape Hatteras to Gulf of Maine) scale.		
Sediment deposition and burial	Ongoing sediment dredging for navigation purposes results in fine sediment deposition. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local, limited to the emplacement corridor. There are also 15 active and 4 inactive/closed dredged material disposal sites within the geographic analysis area for this resource (BOEM 2019b). Sediment deposition could have negative impacts on eggs and larvae, particularly demersal eggs such as longfin squid, which are known to have high rates of egg mortality if egg masses are exposed to abrasion or burial. Impacts may vary based on season/time of year.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.	Dredged material disposal during construction would cause temporary, localized turbidity increases and long-term sedimentation or burial at the immediate disposal site. Cable emplacement / maintenance activities (including dredging) during construction or maintenance of future offshore wind projects could cause sediment suspension and deposition. Sediment deposition could have negative impacts on eggs and larvae, particularly demersal eggs. Impacts may vary based on season and location. Assuming the areal extent of such impacts is proportional to the length of cable installed, such impacts would likely be on the order of 20 times more than under the Proposed Action. Increased sediment deposition may occur during multiple years. The area with a cumulatively greater sediment deposition from simultaneous or sequential activities would be limited, as most of the affected areas would only be lightly sedimented (less than 0.04 inch [1 millimeter]) and would recover naturally in the short term.	The Proposed Action would cause localized and short-term turbidity increases and sediment deposition due to dredged material disposal and cable installation (including pre-lay dredging) during construction. Sediment deposition greater than 0.8 inch (20 millimeters) may extend up to 0.5 mile (0.9 kilometer) from each disposal site and cover up to 34.6 acres (0.1 km^2) (Appendix III-A; Epsilon 2018a). Deposition of 0.04 to 0.2 inch (1 to 5 millimeters) of sediment could potentially occur on up to 2,594 acres (10.5 km^2). These impacts would likely be short-term to long-term. The Proposed Action would not dispose of dredged material in hard-bottom habitats. Installation of submarine cable would mostly be done by jet or mechanical plow. The resultant plume is predicted to stay in the lower portion of the water column (bottom 9.8 feet [2.7 meters]). The portion of the plume that exceeds 10 mg/L typically would extend 656 feet (199.9 meters) from the route centerline but could extend up to 1.2 miles (1.6 kilometers). Modeling showed that sediment concentrations greater than 10 mg/L from dredging could extend up to 10 miles (16 kilometers) from the route centerline and spread through the entire water column. These plumes typically settled within 3 hours but could persist in small areas (15 acres [60,702.8 m^2] or less) for up to 6 to 12 hours (Epsilon 2018c). Dredged material disposal could cause concentrations greater than 1,000 mg/L for a duration of less than 2 hours and a distance of approximately 3 miles (5 kilometers). For this reason, Vineyard Wind expects to use dredging only when necessary in sand wave areas, and not at all within Lewis Bay. A predicted maximum of 3.8 miles (6.1 kilometers) of dredging may occur in the OECC (Table 1-5 in Epsilon 2018c). Attachment C of Epsilon 2018c depicts potential areas of discontinuous dredging. Although turbidity is likely to be high in the affected areas, sediment deposition would have minimal impact outside eelgrass beds and hard-bottom habitats unless sediment is deposited on sensitive life stages. The Proposed Action would not dredge in eelgrass beds or hard-bottom habitats. Because sedimented areas would recover naturally, impacts would be short-term. Sediment could have negative impacts on eggs and larvae, particularly demersal eggs such as longfin squid (*Doryteuthis pealeii*), which deposit eggs within the WDA and adjacent areas are known to have high rates of egg mortality if egg masses are exposed to abrasion or burial; however, the Proposed Action would avoid dredging and export cable installation during the longfin squid spawning season. Overall, the impacts on finfish, invertebrates, and EFH from this IPF would be **minor**.	The Proposed Action would cause sediment deposition on up to 2,594 acres (10.5 km^2); however, sediment deposition would have no impact on finfish, invertebrates, and EFH outside of eelgrass beds and hard-bottom habitats, where the impacts would be **minor**. Ongoing activities cause similar impacts over an unknown extent. Future offshore wind activities (other than the Proposed Action) could also cause similar impacts over an area that is unknown but would likely be similar to the area affected by the Proposed Action, and could also cause impacts to sensitive life stages, such as demersal eggs. Cumulative impacts of sediment deposition and burial on finfish, invertebrates, and EFH associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are likely to be **minor**.
Climate change: Ocean acidification	Continuous carbon dioxide emissions causing ocean acidification may contribute to reduced growth or the decline of invertebrates that have calcareous shells over the course of the next 30 years.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to reduced growth or the decline of finfish, invertebrates, and EFH. Because this sub-IPF is a global phenomenon, impacts on finfish, invertebrates, and EFH though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change. The intensity of impacts resulting from climate change are uncertain, but are anticipated to qualify as **minor** to **moderate**.
Climate change: Warming and sea level rise, altered habitat/ ecology	Climate change, influenced in part by greenhouse gas emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 30 years, influencing the distributions of finfish, invertebrates, and EFH. This sub-IPF has been shown to affect the distribution of fish in the northeast United States, with several species shifting their centers of biomass either	See above.	See above.	See above.	See above.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	northward or to deeper waters (Hare et al. 2016).				
Climate change: Warming and sea level rise, altered migration patterns	See above.	See above.	See above.	See above.	See above.
Climate change: Warming and sea level rise, disease frequency	Climate change, influenced in part by greenhouse gas emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 30 years, influencing the frequencies of various diseases of finfish and invertebrates.	See above.	See above.	See above.	See above.

°C = degrees Celsius; AC = alternating current; BMP = best management practice; BOEM = Bureau of Ocean Energy Management; COP = Construction and Operations Plan; DC = direct current; EFH = essential fish habitat; EMF = electromagnetic field; EIS = Environmental Impact Statement; ESP = electrical service platform; FCC = Federal Communications Commission; G&G = Geological and Geophysical; GW = gigawatts; IPF = impact-producing factors; km^2 = square kilometers; m^2 = square meters; met = meteorological; mg/L = milligrams per liter; NA = not applicable; NOAA = National Oceanic and Atmospheric Administration; O&M = operations and maintenance; OCS = outer continental shelf; OECC = Offshore Export Cable Corridor(s); USACE = United States Army Corps of Engineers; WDA = Wind Development Area; WTG = wind turbine generator

Table 3.5-1: Summary of Activities and the Associated Impact-Producing Factors for Marine Mammals

Baseline Conditions: Past and current impacts on marine mammals involve a variety of anthropogenic impacts, including collisions with vessels (ship strikes), whaling/hunting, entanglement with fishing gear, anthropogenic noise, pollution, disturbance of marine and coastal environments, climate change, effects on benthic habitat, waste discharge, and accidental fuel leaks or spills. Many marine mammal migrations cover long distances, so these factors impact animals over very broad geographical scales.

Regional, pre-existing threats to marine mammals in the Project area include fisheries interactions, vessel traffic, ocean noise, and climate change. Due to the changing water temperatures, ocean currents, and increased acidity, climate change has the potential to impact marine mammals prey distribution and abundance. Specific details regarding baseline conditions for specific species is provided in the Draft EIS Section 3.3.7.1 as well as the project-specific Biological Assessment (BA; BOEM 2019c)

Entanglement in fishing gear in an ongoing threat to marine mammals, and fisheries interactions are likely to have demographic effects on marine mammal species, with estimated global mortality exceeding hundreds of thousands individuals each year (Read et al. 2006). In the Atlantic, bycatch occurs in various gillnet and trawl fisheries in New England and the Mid-Atlantic Coast, with hotspots driven by marine mammal density and fishing intensity (Lewiston et al. 2014; NMFS 2018). Entanglement in fishing gear has been identified as one of the leading causes of mortality in North Atlantic right whales, and may be a limiting factor in the species recovery (Knowlton et al. 2012). Entanglement may also be responsible for high mortality rates in other large whale species. Additionally, bottom trawling and benthic disruption have the potential to result in impacts on prey availability and distribution. However, impacts would be localized and no effects on individual fitness or population level effects would be expected.

Several IPFs related to climate change, including increased storm severity and frequency, increased erosion and sediment deposition, increased disease frequency, ocean acidification, as well as altered habitat, ecology, and migration patterns, have the potential to result in impacts on marine mammals. These long-term, high consequence impacts could include increased energetic costs associated with altered migration routes, reduction of suitable breeding and/or foraging habitat, and reduced individual fitness, particularly juveniles.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/hazmat	See Table A-8 in Appendix A for a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal effects on the individual fitness, including adrenal effects, hematological effects, liver effects lung disease, poor body condition, skin lesions, and several other health affects attributed to oil exposure (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008, Smith et al. 2017; Sullivan et al. 2019; Takeshida et al. 2017). Additionally, accidental releases may result in impacts on marine mammals due to effects to prey species (Table 3.4-1).	See Table A-8 in Appendix A for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal effects on the individual fitness, including adrenal effects, hematological effects, liver effects lung disease, poor body condition, skin lesions, and several other health affects attributed to oil exposure (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008, Smith et al. 2017; Sullivan et al. 2019; Takeshida et al. 2017). Additionally, accidental releases may result in impacts on marine mammals due to effects to prey species (Table 3.4-1).	Similar to future non-offshore wind activities, accidental releases from offshore vessel usage, spills and releases associated with vessel traffic resulting from future offshore wind development will likely continue on a similar trend as described under Ongoing Activities. Impacts resulting from accidental releases may pose a long-term risk to marine mammals and could potentially lead to mortality and sublethal impacts on individuals present in the vicinity of the spill, but the potential for exposure would be limited give the isolated nature of these accidental releases and the patchy distribution of marine mammals in the geographic analysis area.	Given that vessel discharges would be limited to uncontaminated or treated liquids impact on water quality, and thus to marine mammals would not be expected to occur. As described in the Draft EIS, the mostly likely type of accidental release of hazardous materials would range from 90 to 440 gallons (Bejarano 2013) and result in localized, temporary, **negligible** impacts on marine mammals. Impacts on individual marine mammals, including decreased fitness, health effects, and mortality, may occur, if present in the vicinity of the spill, but accidental releases are expected to be rare and injury or mortality would not be expected to occur. Further, all vessels associated with the Proposed Action would comply with the USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize effects on marine mammals resulting from the release of debris, fuel, hazmat, or waste (BOEM 2012).	See Table A-8 in Appendix A for a quantitative analysis of these risks. The Proposed Action could lead to an increased potential for a release that may result in localized and temporary **negligible** impacts, including individual mortality, decreased individual fitness, and health effects. However, all vessels associated with the Proposed Action would comply with the USCG requirements for the prevention and control of oil and fuel spills, minimizing effects on marine mammals resulting from the release of debris, fuel, ha, or waste (BOEM 2012). The impacts from ongoing activities and future non-offshore wind activities stem from the increased potential for releases over the next 30 years due to increasing vessel traffic and ongoing releases, which are frequent/chronic. Future offshore wind activities would contribute to an increased risk of spills and impacts on marine mammals, including mortality, health effects, and decreased fitness due to fuel/fluid/hazmat exposure. The contribution from future offshore wind and the Proposed Action would be a low percentage of the overall spill risk from ongoing activities. Cumulatively, the impacts on marine mammals (mortality, decreased fitness, and health effects) from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be localized, temporary, and **negligible** due to the likely limited extent and duration of a release, described in detail in the Draft EIS Section 3.2.2.3.
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying, and debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Worldwide 62 of 123 (50.4%) marine mammal species have been documented ingesting marine litter (Werner et al. 2016). Stranding data	As population and vessel traffic increase gradually over the next 30 years, accidental release of trash and debris may increase. Trash and debris may continue to be accidentally released through fisheries use and other offshore and onshore activities. There may also be a long-term risk from exposure to plastics and other debris in the ocean. Worldwide 62 of 123 (50.4%) of marine mammal species	Trash and debris may be released by vessels during construction, operations, and decommissioning. BOEM assumes operator compliance with federal and international requirements for management of shipboard trash; such events also have a relatively limited spatial impact. While precautions to prevent accidental releases would be employed by vessels and port operations associated with future 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. In	Trash and debris may be released by vessels during construction, operations, and decommissioning. BOEM assumes operator compliance with federal and international requirements for management of shipboard trash; such events also have a relatively limited spatial impact. While precautions to prevent accidental releases would be employed by vessels and port operations associated with the Vineyard Wind 1 Project, it is likely that some debris could be lost overboard during construction, maintenance, and routine vessel activities. However, the amount would likely be miniscule compared to other inputs. In the event of a release of trash and debris, it would be an accidental,	The Proposed Action could lead to non-measurable **negligible** impacts on marine mammals, ranging from decreased fitness to mortality. However, BMPs proposed for waste management and mitigation for marine debris training and awareness of project personnel will be required, reducing the likelihood of occurrence to a very low risk. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature but a greater spatial and temporal extent. Future offshore wind activities would likely result in much more accidental trash and debris releases relative to the Proposed Action, but the overall risk would still be considered low. Cumulatively, the expected **negligible** impacts on marine mammals through this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	indicate potential debris induced mortality rates of 0 to 22%. Mortality has been documented in cases of debris interactions, as well as blockage of the digestive track, disease, injury, and malnutrition (Baulch and Perry 2014). However, it is difficult to link physiological effects to individuals to population level impacts (Browne et al. 2015).	have been documented ingesting marine litter (Werner et al. 2016). Mortality has been documented in cases of debris interacts, as well as blockage of the digestive track, disease, injury, and malnutrition (Baulch and Perry 2014).	the event of a release of trash and debris, it would be an accidental, low probability event in the vicinity of project areas.	localized event in the vicinity of the Project area or the areas from ports to the Project area used by vessels, likely resulting in non-measurable **negligible** impacts, if any. Further, proposed BMPs for waste management and mitigation as well as marine debris awareness and elimination training for the Vineyard Wind 1 Project personnel would be required, reducing the likelihood of an accidental release.	are expected to be localized and short-term, with the Proposed Action having little to no influence on cumulative impacts through this sub-IPF.
EMF	EMFs emanate constantly from installed telecommunication and electrical power transmission cables. In the marine mammal geographic analysis area, there are six existing power cables connecting Martha's Vineyard and Nantucket to the mainland. Marine mammals appear to have a detection threshold for magnetic intensity gradients (i.e. changes in magnetic field levels with distance) of 0.1% of the earth's magnetic field or about 0.05 μT (Kirschvink 1990) and are thus likely to be very sensitive to **minor** changes in magnetic fields (Walker et al. 2003). There is a potential for animals to react to local variations of the geomagnetic field caused by power cable EMFs. Depending on the magnitude and persistence of the confounding magnetic field, such an effect could cause a trivial temporary change in swim direction or a longer detour during the animal's migration (Gill et al. 2005). Such an effect on marine mammals is more likely to occur with direct current cables than with AC cables (Normandeau et al. 2011). However, there are numerous transmission cables installed across the seafloor and no impacts on marine mammals have been demonstrated from this source of EMF.	During operation, future new cables would produce EMF. Submarine power cables in the marine mammal geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. (Section 5.2.7 of BOEM 2007.) EMF of any two sources would not overlap. Although the EMF would exist as long as a cable was in operation, impacts, if any, would likely be difficult to detect, if they occur at all. Marine mammals have the potential to react to submarine cable EMF, however, no effects from the numerous submarine cables have been observed. Further, this IPF would be limited to extremely small portions of the areas used by migrating marine mammals. As such, exposure to this IPF would be low, and as a result impacts on marine mammals would not be expected.	In the expanded cumulative scenario, up to 5,947 miles (9,571 kilometers) of cable would be added in the marine mammal geographic analysis area, producing EMF in the immediate vicinity of each cable during operations. Marine mammals have the potential to react to submarine cable EMF, however, no effects from the numerous submarine cables have been observed. Further, this IPF would be limited to extremely small portions of the areas used by migrating marine mammals. As such, exposure to this IPF would be low, and as a result, impacts such as changes in swimming direction and altered migration routes would not be expected.	EMF would emanate from any active cable during operations. The shielding and burial depths proposed would minimize EMF intensity and extent. Given the extremely small area where exposure to this IPF would occur and the proposed burial depth of the submarine cable, no measurable impacts such as changes in swimming direction and altered migration routes would be expected. These effects on marine mammals are more likely to occur with direct current cables than with AC cables (Normandeau et al. 2011). Because AC cables have been proposed for the Vineyard Wind 1 Project and the Project area represents an extremely small area within the coastal waters used by migrating marine mammals, BOEM expects non-measurable **negligible** impacts, if any, on migratory behavior of marine mammals.	The Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on marine mammals through this IPF due to the localized nature of EMF along Project cables near the seafloor, wide ranges of marine mammals, and appropriate shielding and burial depth. Ongoing and future non-offshore wind activities may have similar effects. Future offshore wind activities would likely result in the same type of impacts, but with a greater spatial and extent than ongoing activities. Cumulatively, the expected **negligible** impacts on marine mammals through this IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be long-term, but highly localized, with the Proposed Action having little to no influence on cumulative impacts through this IPF.
New cable emplacement/ maintenance	Cable maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be local and generally limited to the emplacement corridor. Data are not available regarding marine mammal avoidance of localized turbidity plumes; however, Todd et al. (2015) suggest that since some marine mammals often live in turbid waters and some species of mysticetes and sirenians employ feeding methods that create sediment plumes, some species of marine mammals have a tolerance for increased turbidity. Similarly, McConnell et al. (1999) documented movements and foraging of grey seals in the North Sea. One tracked individual was blind in both eyes, but otherwise healthy. Despite being blind, observed movements were typical of the other study individuals, indicating that visual cues are not essential for grey seal foraging and movement (McConnell et al. 1999). If elevated turbidity caused any behavioral responses such as avoiding the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any impacts would be temporary and short-term. Turbidity associated with increased sedimentation may result in temporary, short-term impacts on marine mammal prey species (Table 3.4-1).	The FCC has two pending submarine telecommunication cable application in the North Atlantic. The impact on water quality from accidental sediment suspension during cable emplacement is temporary and short-term. If elevated turbidity caused any behavioral responses such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any negative impacts would be temporary and short-term. Turbidity associated with increased sedimentation may result in temporary, short-term impacts on some marine mammal prey species (Table 3.4-1).	Future offshore wind development would require new cabling to bring generated electricity onshore, and would result in sea floor disturbance and elevated levels of suspended sediment. Assuming similar installation procedures as the proposed Project, the duration and range of impacts would be limited and the resource would recover following the disturbance. Impacts would occur during construction and would involve increased turbidity for 1 to 6 hours at a time. Short-term effects on individual marine mammals could occur in the immediate vicinity of installation activities. The total area of direct seafloor disturbance is estimated to be up to 8,153 acres (33 km^2). These disturbances will be local and generally limited to the emplacement corridor. Further, suspended sediment concentrations in Nantucket Sound under natural conditions are 45 to 71 mg/L. Suspended sediment concentrations due to jet plow are within the range of natural variability for this area. The impact on water quality from sediment suspension during cable laying activities would be temporary and short-term. 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 temporary and short-term. Turbidity associated with increased sedimentation may result in short-term, temporary impacts on marine mammal prey species (Table 3.4-1).	Installation of submarine cable would mostly be done by jet or mechanical plow. The modeled resultant plume is predicted to stay in the lower portion of the water column (bottom 9.8 feet). The portion of the plume that exceeds 10 mg/L typically would extend 656 feet from the route centerline but could extend up to 1.2 miles Modeling showed sediment concentrations greater than 10 mg/L from dredging could extend up to 10 miles (16 kilometers) from the route centerline and spread through the entire water column. These plumes typically settled within 3 hours but could persist in small areas (15 acres [60,702.8 m^2] or less) for up to 6 to 12 hours (Epsilon 2018a). Dredged material disposal could cause concentrations greater than 1,000 mg/L for a duration of less than 2 hours and a distance of approximately 3 miles (5 kilometers). For this reason, Vineyard Wind expects to use dredging only when necessary in sand wave areas, and not at all within Lewis Bay. A predicted maximum of 3.8 miles (6.1 kilometers) of dredging may occur in the OECC (Table 1-5 in Epsilon 2018a). Attachment C of Epsilon 2018a depicts potential areas of discontinuous dredging. Although turbidity is likely to be high in the affected areas, the sediment no longer impacts water quality once it has settled. If elevated turbidity caused any behavioral responses such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary, only occurring for less than 2 to 6 hours per day from April through October (Vineyard Wind 2018a), and any negative impacts would be short-term and temporary. Because the period of sediment suspension is very localized and short-term and the use of dredging is restricted, non-measurable **negligible** impacts, if any, would be expected.	The Proposed Action estimated that up to 328 acres (1.3 km^2) of sea floor could be disturbed by cable installation and that up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation, potentially leading to short-term **negligible** impacts due to reduced foraging success and displacement, though no biologically significant impacts would be expected. Ongoing and future non-offshore wind activities may cause similar local, short-term impacts. Future offshore wind activities other than the Proposed Action would disturb up to 8,153 acres (33 km^2), though impacts would not be expected to be biologically significant. No measurable cumulative impacts on marine mammals would be attributed to the Proposed Action. Some non-measurable **negligible** cumulative impacts arising from future development, including future offshore wind, could occur if impacts occur in close temporal and spatial proximity, though these impacts would not be expected to be biologically significant (NOAA 2020).

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Noise: Aircraft	Aircraft routinely travel in the marine mammal geographic analysis area. With the possible exception of rescue operations, no ongoing aircraft flights would occur at altitudes that would elicit a response from marine mammals. If flights are at a sufficiently low altitude, marine mammals may respond with behavioral changes, including short surface durations, abrupt dives, and percussive behaviors (i.e. breaching and tail slapping) (Patenaude et al. 2002). These brief responses would be expected to dissipate once the aircraft has left the area. Similarly, aircraft have the potential to disturb hauled out seals if aircraft overflights occur within 2,000 feet (610 meters) of a haul out area (Efroymson et al. 2000). However, this disturbance would be temporary, short-term, and result in minimal energy expenditure. These brief responses would be expected to dissipate once the aircraft has left the area.	Future low altitude aircraft activities such as survey activities and navy training operations could result short-term responses of marine mammals to aircraft noise. If flights are at a sufficiently low altitude, marine mammals may respond with a behavior changes, including short surface durations, abrupt dives, and percussive behaviors (i.e. breaching and tail slapping) (Patenaude et al. 2002). These brief responses would be expected to dissipate once the aircraft has left the area.	Future offshore wind development may require the use of helicopters to supplement crew transport during construction and operations. BOEM expects that helicopters transiting to the offshore WDAs would fly at altitudes above those that would cause behavioral responses from marine mammals except when flying low to inspect WTGs or take off and land on the SOV. If a listed whale is within 250 to 360 m of the helicopter, it is possible that behavior responses may occur, but they are expected to be temporary and short-term. NARW approach regulations (50 CFR 222.32) prohibit approaches within 500 yards. BOEM will require all aircraft operations to comply with current approach regulations for any sighted NARWs or unidentified large whale. While helicopter traffic may cause some temporary and short-term behavioral reactions in marine mammals while helicopters move to a safe distance, BOEM does not expect it to cause injury. Similarly, aircraft have the potential to disturb hauled out seals if aircraft overflights occur within 2000 feet (610 meters) of a haul out area. However, this disturbance would be temporary, short-term, and result in minimal energy expenditure.	Vineyard Wind may use helicopters to supplement crew transport and for Proposed Action support during both construction and operations (COP Section 4.2.4, Volume I; Epsilon 2018a) and may cause behavioral changes to NARWs, fin, and sei whales. Aircraft operation may ensonify areas, albeit for short periods at any one location while in transit. BOEM expects that helicopters transiting to the Project area would fly at altitudes above those that would cause behavioral responses from marine mammals except when flying low to inspect WTGs or to take off and land on the SOV. If a listed whale is within 250 to 360 meters of the helicopter, it is possible that behavior responses may occur, but they are expected to be temporary and short-term. NARW approach regulations (50 CFR 222.32) prohibit approaches within 500 yards. BOEM will require all aircraft operations to comply with current approach regulations for any sighted NARWs or unidentified large whale. While helicopter traffic may cause some short-term behavioral reactions in marine mammals while helicopters move to a safe distance, BOEM expects these impacts on be **negligible**. Similarly, aircraft have the potential to disturb hauled out seals if aircraft overflights occur within 2000 feet of a haul out area. However, this disturbance would be temporary, short-term, and result in minimal energy expenditure.	The proposed Action may result in non-measurable **negligible** behavioral responses, including short surface durations, abrupt dives, startle response, and percussive behaviors, through this sub-IPF. Aircraft operations associated with the Vineyard Wind 1 Project are not expected to occur in great numbers, but could possible occur during operations and mitigation-related surveys during construction. Impacts resulting from ongoing and future offshore development would be limited to rescue operations and would be expected to result in similar impacts on marine mammals. Future offshore wind activities would likely result in much more aircraft flights than the Proposed Action, but the overall impacts on individuals would still be considered low, and no biologically significant impacts would be expected. Cumulatively, the impacts on marine mammals through this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be localized and short-term, with non-biologically significant **negligible** impacts expected to result. The Proposed Action would have little to no influence on cumulative impacts through this sub-IPF.
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities have the potential to result in high intensity, high consequence impacts, including auditory injuries, stress, disturbance, and behavioral responses, if present within the ensonified area (NOAA 2018a). Survey protocols and underwater noise mitigation procedures are typically implemented to decrease the potential for any marine mammal to be within the area where sound levels are above relevant harassment thresholds associated with an operating sound source to reduce the potential for behavioral responses and injury (PTS/TTS) close to the sound source. The magnitude of effects, if any, is intrinsically related to many factors, including: acoustic signal characteristics, behavioral state (e.g., migrating), biological condition, distance from the source, duration and level of the sound exposure, as well as environmental and physical conditions that affect acoustic propagation (NOAA 2018a).	Same as ongoing activities, with the addition of possible future oil and gas exploration surveys.	Site characterization surveys for offshore wind facilities would create intermittent, high-intensity impulsive noise around sites of investigation over a 2- to 10-year period. Sound sources used during G&G activities have the potential to produce stress, disturbance, and behavioral responses in marine mammals if they are present within the ensonified area (NOAA 2018a). Survey protocols and underwater noise mitigation procedures are implemented to decrease the potential for any marine mammal to be within the area where sound levels are above relevant harassment thresholds associated with an operating sound source to reduce the potential for behavioral responses and injury (PTS/TTS) close to the sound source. Seismic surveys can extend over a time scale of months, as does construction and installation of wind energy structures. However, identifying the locations and schedules of wind energy G&G and construction/installation activities as well as ongoing and future non-offshore wind G&G surveys could avoid overlapping noise impacts by scheduling activities to avoid cumulative impacts on marine mammals. BOEM concluded disturbance of marine mammals from underwater noise generated by site characterization and site assessment activities would likely result in temporary displacement and other behavioral or physiological consequences (BOEM 2019c) and impacts on marine mammals would not result in stock or population level effects.	Noise from G&G surveys during inspection and/or monitoring of cable routes may occur during construction and operations. Higher frequency non-airgun HRG survey noise resulting from cable route surveys may be less intense than G&G noise from site investigation surveys in WDAs. Due to the higher frequency, only a few HRG sources (sub-bottom profilers, boomers, and sparkers) are detectable by marine mammals (BOEM 2018). Additionally, HRG surveys are lower energy and operate in smaller areas, and as such, the associated ensonified area is smaller, though impacts on marine mammals could occur at close ranges (within 656 feet [200 meters]). No injury to individuals would be expected as these sound sources have been shown to diminish rapidly with distance from the source (BOEM 2018). Impacts, if any, are anticipated to be temporary and **negligible**. Additionally, G&G surveys associated with the Proposed Action would be conducted in accordance with a project-specific IHA to minimize impacts on marine mammals.	G&G survey noise from the Proposed Action may result in temporary **negligible** impacts, including behavioral and physiological effects and injury along the cable routes during inspection. Compliance with the project-specific IHA would ensure that impacts remain **negligible**. Ongoing and future non-offshore wind impacts may result in similar types of impacts over an unknown extent. These activities would be conducted in compliance with project-specific IHAs, which require anticipated impacts to be **negligible**. Future offshore wind other than the Proposed Action would likely affect a much greater area than the Proposed Action would, but would also be subject to project-specific IHA requirements. As all potential activities associated with this sub-IPF would require compliance with a project-specific IHA, all impacts would be **negligible**. As such, cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be **negligible**.
Noise: Turbines	Marine mammals would be able to hear the continuous underwater noise of operational WTGs. As measured at the Block Island Wind Facility, this low frequency noise barely exceeds ambient levels at 164 feet (50 meters) from the WTG base. Based on the results of Thomsen et al. (2015) and Kraus et al. (2016), sound pressure levels would be expected to be at or below ambient levels at relatively short distances from the WTG foundations.	This sub-IPF does not apply to future non-offshore wind development.	According to measurements at the Block Island Wind Facility, low frequency noise generated by turbines reaches ambient levels at 164 feet (50 meters; Miller and Potty 2017). Sound pressure level measurements from operational WTGs in Europe indicate a range of 109 to 127 dB re 1µPa at 46 and 65.6 feet (14 and 20 meters) from the WTGs (Tougaard and Henrikson 2009). Although sound pressure levels may be different in the local conditions of the project areas, if sound levels at the project areas are similar, operational noise could be slightly higher than ambient, which ranged from 96 to greater than 103 dB re 11µPa in the 70.8– 224 Hz frequency band at the study area during 50% of the recording time between	According to measurements at the Block Island Wind Facility, low frequency noise generated by turbines reaches ambient levels at 164 feet (50 meters; Miller and Potty 2017). Sound pressure level measurements from operational WTGs in Europe indicate a range of 109 to 127 dB re 1µPa at 46 and 65.6 feet (14 and 20 meters) from the WTGs (Tougaard and Henrikson 2009). Although sound pressure levels may be different in the local conditions of the WDA, if sound levels at the WDA are similar, operational noise could be slightly higher than ambient, which ranged from 96 to greater than 103 dB re 11µPa in the 70.8 to 224 Hz frequency band at the study area during 50% of the recording time between November 2011 and March 2015 (Kraus et al. 2016). Based on the	The Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on marine mammals through this sub-IPF due to the assumption that operational turbine noise would be similar to ambient noise levels within 164 feet (50 meters) of the WTG foundations (Miller and Potty 2017). No impacts would occur from ongoing and future non-offshore wind development. Future offshore wind (other than the Proposed Action) would be expected to result in similar impacts, but across a greater spatial scale. **Negligible** cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities, if any, would be expected due to operational turbine noise given the assumption that operational turbine noise would be similar to ambient levels within a short distance (164 feet [50 meters]) of WTG bases.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			November 2011 and March 2015 (Kraus et al. 2016). Based on the results from Thomsen et al. (2016) and Kraus et al. (2016), the received SPLs generated by the Project turbines are expected to be at or below ambient levels at relatively short distances from the foundations. Given that WTG noise would be at or below ambient within a short distance from WTG bases, no measurable impacts from this sub-IPF would be expected to occur.	results from Thomsen et al. (2016) and Kraus et al. (2016), the received SPLs generated by the Project turbines are expected to be at or below ambient levels at relatively short distances from the foundations. Given that WTG noise would be at or below ambient within a short distance from WTG bases, non-measurable **negligible** impacts, if any, would be expected to occur.	
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can result in high-intensity, low-exposure level, long-term, but localized intermittent risk to marine mammals. Impacts would be localized in nearshore waters. Pile driving activities may negatively affect marine mammals during foraging, orientation, migration, predator detection, social interactions, or other activities (Southall et al. 2007). Noise exposure associated with pile-driving activities can interfere with these functions, and have the potential to cause a range of responses, including insignificant behavioral changes, avoidance of the ensonified area, PTS, harassment, and ear injury, depending on the intensity and duration of the exposure. BOEM assumes that all ongoing and potential future activities will be conducted in accordance with a project-specific IHA to minimize impacts on marine mammals.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.	Noise from pile driving would occur during installation of foundations for offshore structures for 4 to 6 hours at a time over a 6- to 12-year period. Under the expanded cumulative impact scenario, up to 2,021 WTGs and 45 ESPs would be constructed incrementally over time, beginning in 2022 and continuing through 2030. Pile-driving activities may affect marine mammals during foraging, orientation, migration, predator detection, social interactions, or other activities (Southall et al. 2007). Whales would be displaced up to 6 hours per day during monopile installation and up to 14 hours per day during jacket installation. Thus, foraging disruptions would be temporary and are not expected to last longer than a day. This displacement would result in a relatively small energetic consequence that would not be expected to have long-term impacts on whales. Although information is lacking, construction activities could temporarily displace animals into are areas that have a lower foraging quality, or result in higher risk of interactions with ships or fishing gear. Potential cumulative effects on marine mammals from multiple construction activities within the same calendar year could impact migration, feeding, calving, and individual fitness. Intermittent, long-term impacts may be high-intensity and high-exposure level. The magnitude of these impacts would be dependent upon the locations of concurrent construction operations as well as the number of hours per day, the number of days, and the time of year that pile driving would occur.	There is a potential risk of PTS and harassment to marine mammals from pile driving due to the large radial distance to this threshold and the maximum-case scenario of a total of 102 days that pile driving may occur. As part of the proposed Project, Vineyard Wind has committed to voluntarily implement measures of utilizing soft start, PSOs, and PAM to reduce the potential impacts on marine mammals. Additionally, the peak season of NARW occurrence between January and April will be completed avoided and no pile driving will occur at that time. Additional details on the measures that Vineyard Wind has committed to voluntarily implement are described in detail in Pyć et al. 2018 and in the BA submitted to NOAA (BOEM 2019c). Overall, the modeled predicted exposure rates indicate that impacts would be expected to be negligible for mid- and high-frequency cetaceans and pinnipeds for both potential injury and behavior disruption based upon the number of individuals affected relative to the size of the overall populations. In this group, only the sperm whale (*Physeter macrocephalus*) is endangered, but it would not be expected to be exposed to pile driving noise due to low densities and preference for deep water (Pyć et al. 2018). For low-frequency cetaceans, under the maximum-case scenario, the modeled predicted risk of injury was a very low percentage of species abundance, without sound attenuation or aversion used in the modeled scenarios (Pyć 2018). Based on the analysis, BOEM considers impacts from pile driving to be **minor** for NARW (*Eubalaena glacialis*) due to avoidance of peak seasons of occurrence and **moderate** for all other marine mammals.	Pile driving noise associated with the Proposed Action may result in **minor** to **moderate** temporary impacts, including behavioral and physiological effects and injury, along the cable routes during inspection. Given that pile-driving activities would be conducted in accordance with a Project-specific IHA, as well as additional measures Vineyard Wind has voluntarily committed to implement such as the use of soft-start procedures, PSOs, and PAM, impacts on marine mammals through this sub-IPF would be expected to be reduced to **negligible** levels. Pile driving associated with ongoing, future non-offshore wind, and future offshore wind activities would also be conducted in accordance with a project-specific IHA that would avoid, minimize and mitigate for impacts on marine mammals While pile driving associated with individual projects are required to be **negligible** in order to comply with project-specific IHAs, cumulatively pile-driving noise may result in greater impacts on marine mammals. The only project that is anticipated to overlap with the Proposed Action is the South Fork project. Given that the South Fork Project has committed to similar mitigation measures as the Proposed Action (seasonal restrictions, PSOs, PAM, and others) cumulative impacts are expected to be **moderate**. At this time there is no available information regarding the potential mitigation measures that would be applied to pile-driving activities associated with other future offshore wind development. As such, cumulative impacts could be even greater.
Noise: Cable laying/trenching	N/A	Cable laying impacts resulting from future non-offshore wind activities would be identical to those described for future offshore wind projects.	Noise associated with cable laying would be produced during route identification, trenching and backfilling, and cable protection installation by vessels and equipment, with intensity and propagation dependent upon bathymetry, local seafloor characteristics, vessels and equipment used (Taormina et al. 2018). Modeling using *in situ* data collected during cable-laying operations in Europe estimate that underwater noise would remain above 120 dB re 1µPa in an area of 98,842 acres (400 km²) around the source (Bald et al. 2015; Nedwell and Howell 2004, Taormina et al. 2018). Currently, there is no indication that noise associated with cable laying affects marine mammals, though models shows that the predicted impact ranges for cable laying are much smaller than those modeled for other activities, such as pile driving and seismic surveys (Nedwell and Howell 2004; Taormina et al. 2018). Though impact ranges are smaller, cable-laying activities may affect marine mammals during foraging, orientation, migration, predator detection, social interactions, or other activities (Southall et al. 2007). If cable-laying activities are assumed to occur 24 hours per day, the DP vessel would be continually moving along the cable route over a 24-hour period, the area within the 120 dB RMS isopleth would also be constantly moving over the same period. Thus, the estimated ensonified areas would not remain in the same location for more than a few hours (NMFS 2015). NMFS (2015) determined that any whales that	Noise associated with cable laying would be produced during route identification, trenching and backfilling, and cable protection installation by vessels and equipment, with intensity and propagation dependent upon bathymetry, local seafloor characteristics, vessels and equipment used (Taormina et al. 2018). Model results from DP thruster operation for the Deepwater Wind Project (NMFS 2015) indicated that the average ensonified area at the 120 dB RMS isopleth extends 2.95 miles (4.75 kilometers) from the source, with the total size of the area experiencing noise of 120 dB RMS or greater ranging from 8.9 square miles (23 km²) along the offshore export route to 9.7 square miles (25.1 km²) along the inter-array cable route. If cable-laying activities are assumed to occur 24 hours per day, the DP vessel would be continually moving along the cable route over a 24-hour period, the area within the 120 dB RMS isopleth would also be constantly moving over the same period. Thus, the estimated ensonified areas would not remain in the same location for more than a few hours (NMFS 2015). NMFS (2015) determined that any whales The radial distance to the threshold criteria for Level A Harassment or Level B Harassment for marine mammals in the Project area is not known. The distance to the threshold for Level A Harassment is expected to be relatively small and the distance to threshold for Level B Harassment is expected to be in the range of other vessel noise. BOEM therefore anticipates **minor** temporary impacts from cable laying noise, with marine mammal populations fully recovering following cable installation.	The proposed Action is expected to result in **minor** impacts on marine mammals through this sub-IPF, with marine mammals resuming normal behaviors once individuals are outside of the ensonified area. Future non-offshore wind development would be expected to result in similar localized and temporary impacts, but across a smaller geographic scale. Cable-laying impacts associated with future offshore wind development would also result in similar localized and temporary impacts, but on a larger temporal and spatial scale. Cumulatively little spatial and/or temporal overlap from the Proposed Action and future activities would be expected. A portion of BSW's Export Cable 2 (as it approaches landfall) may be near enough to the OECC that the areas of potential effects from these cables may overlap (assuming a 10-mile [16.1-kilometer] radius around both cables) (see the BSW Project Overview map in Evans 2018). Other than this project all noise related to cable installation would be separated in space and time, and as such, minor cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities relative to this sub-IPF would be expected.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			may be foraging in the action area and are exposed to cable-laying noise are expected to continue foraging, but may forage less efficiently due to increased energy spent on vigilance behaviors. This change may have short-term metabolic consequences for individual animals and may result in a period of physiological stress; however, this stressed state and less efficient foraging is only expected to last as long as prey distribution overlaps with the area ensonified above 120 dB RMS, which is expected to be temporary.		
Noise: Vessels	See Section 3.13. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, scientific and academic research vessels, as well as other construction vessels. The frequency range for vessel noise falls within marine mammals' known range of hearing and would be audible. Noise from vessels presents a long-term and widespread impact on marine mammals across in most oceanic regions. While vessel noise may have some effect on marine mammal behavior, it would be expected to limited to brief startle and temporary stress response. Results from studies on acoustic impacts from vessel noise on odontocetes indicate that small vessels at a speed of 5 knots in shallow coastal water can reduce the communication range for bottlenose dolphins within 164 feet (50 meters) of the vessel by 26% (Jensen et al. 2009). Pilot whales in a quieter, deep-water habitat could experience a 50% reduction in communication range from a similar size boat and speed (Jensen et al. 2009). Since lower frequencies propagate farther away from the sound source compared to higher frequencies, low frequency cetaceans are at a greater risk of experiencing Level B Harassment produced by vessel traffic.	See Section 3.13. Any offshore projects that require the use of ocean vessels could potentially result in long term but infrequent impacts on marine mammals, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes. However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of marine mammals and no stock or population level effects would be expected.	Any offshore projects that require the use of ocean vessels could potentially result in moderate intensity, long term, infrequent impacts on marine mammals, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes (Erbe et al. 2018, Erbe et al. 2019, Nowacek et al. 2007). However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of marine mammals and no population level effects would be expected.	No whales are expected to be exposed to PTS-causing SPLs from vessel noise. Although the radial distance in which harassment may occur is relatively large, vessels are transitory noise sources and are expected to have short-term and **minor** to **moderate** effects of an animal's behavior with no resulting injury to individuals. Communication between animals within and located on different sides of the Project area could be intermittently masked as vessels are transiting through the area on a daily basis. This masking is expected to last intermittently while animals remain in the area. Since the greatest amount of vessel traffic will occur concurrently with pile driving activities, whales may choose to leave the area during construction. In either scenario, some short-term harassment is expected to occur due to vessel operations or pile driving during construction. Restrictions on vessel approaches near whales will ensure that project vessels are never within 1,640 feet (500 meters) of NARWs and 328 feet (100 meters) from all other whales, minimizing the exposure to harassment from vessels. In non-peak vessel traffic periods, exposure to listed-whales within the Action Area is expected to be transient and temporary, as individual vessels pass by along their route, and whale behavior and use of the habitat would be expected to return to normal following the passing of a vessel (NMFS 2015). Thus, as no avoidance behaviors are anticipated and any effects to listed whale species from Project vessel noise outside of the construction period would be **negligible**.	The Proposed Action is expected to result in **minor** to **moderate** impacts on marine mammals through this sub-IPF during the construction and decommissioning phases and **minor** during operations and maintenance. Ongoing and future non-offshore wind activities would be expected to result in similar impact on marine mammals but would have much larger impact given the volume of vessel traffic associated with these activities. Future offshore wind would also have similar impacts on marine mammals, but with a larger spatial extent than the Proposed Action. Cumulatively the Proposed Action and other future offshore wind development would be expected to contribute **minor** to **moderate**, impacts on marine mammals, depending on project phase. However, the Proposed Action and other future offshore wind development would contribute only a small portion of the overall vessel traffic in the region (BOEM 2019b).
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Port expansion activities are localized to nearshore habitats, and are expected to result in temporary, short-term impacts, if any, on marine mammals. Vessel noise may affect marine mammals, but response would be expect to be temporary and short-term (see Vessels: Noise sub-IPF above). The impacts on water quality from sediment suspension during port expansion activities is temporary, short-term, and would be similar to those described under the New cable emplacement/maintenance IPF above.	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications. Future channel deepening activities are being undertaken to accommodate deeper draft vessels for the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long-term depending on the vessel traffic increase. However, the existing suspended sediment concentrations in Nantucket Sound are already 45-71 mg/L, which is fairly high. Impacts from vessel traffic are likely to be masked by the natural variability. Certain types of	There are at least two proposed offshore wind project that are contemplating port expansion/ modification, in Vineyard Haven and in Montauk. It is likely that other ports would be upgraded along the east coast, and some of this may be attributable to supporting the offshore wind industry. This would increase the total amount of disturbed benthic habitat, potentially resulting in impacts on some marine mammal prey species. However, this will likely be a small percentage of available benthic habitat overall. Increases in port utilization due to other offshore wind energy projects will lead to an increased vessel traffic. This increase in vessel traffic will be at its peak during construction activities and will decrease during operations but will increase again during decommissioning. In addition, any related port expansion and construction activities related to the additional offshore wind projects would add to increased turbidity in the coastal waters. Impacts associated with increased turbidity are not expected to be biologically significant (NOAA 2020).	No port expansion is proposed for the Vineyard Wind 1 Project.	Given that no port expansion is proposed, the Vineyard Wind 1 Project would not be expected to contribute to this sub-IPF or cumulative impacts on marine mammals. Port expansion as a result of ongoing and non-offshore wind activities may have some temporary water quality impacts as well as long-term impacts relative to increased potential for vessel collisions as a result of increased vessel traffic. Port modifications, if contemplated, would most likely occur in areas that are already industrialized, have a high level of anthropogenic activity, and have been previously altered. Port expansion associated with future offshore wind development may result in similar impacts, but the incremental increase from offshore wind development would be a minor contributor to port expansion required to meet commercial, industrial, and recreational demand. The current bearing capacity of existing ports was considered suitable for wind turbines, requiring no port modifications for supporting offshore wind energy development (DOE 2014). Cumulatively, the impacts on marine mammals through this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be localized and short-term, with non-biologically significant **negligible** impacts. The Proposed Action t would have little to no influence on cumulative impacts through this sub-IPF.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
		vessel traffic have increased recently (e.g. ferry use and cruise industry) and may continue to increase in the foreseeable future. Additional impacts associated with the increased risk of vessel strike could also occur (see the Traffic: Vessel collisions sub-IPF below).			
Presence of structures: Entanglement or ingestion of lost fishing gear	There are more than 130 artificial reefs in the Mid-Atlantic region. This sub-IPF may result in long-term, high intensity impacts, but with low exposure due to localized and geographic spacing of artificial reefs, long-term. Currently bridge foundations and the Block Island Wind Facility may be considered artificial reefs and may have higher levels of recreational fishing, which increases the chances of marine mammals encountering lost fishing gear, resulting in possible ingestions, entanglement, injury, or death of individuals (Moore and van der Hoop 2012), if present nearshore where these structures are located. There are very few, if any, areas within the OCS geographic analysis area for marine mammals that would serve to concentrate recreational fishing and increase the likelihood that marine mammals would encounter lost fishing gear.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.	Development of the projects in the expanded cumulative scenario would install more buoys, met towers, foundations, and hard protection. Approximately 2,944 acres (12 km^2) new scour protection and hard protection atop cables, and the vertical surfaces of up to 2,066 new foundations would increase the risk of gear loss/damage by entanglement and the ensuing impacts on sea turtles over an assumed 6- to 10-year period beginning in 2022 and that they would remain until decommissioning of each facility is complete (30 years). The presence of structures and the anticipated reef effect has the potential to lead to increased recreational fishing within the WDAs and result in moderate exposure, high intensity risk of interactions with fishing gear that may lead to entanglement, ingestion, injury, and death (Moore and van der Hoop 2012).	The Proposed Action is expected to add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations would remain for the life of the Project, and scour/cable protection would likely remain permanently. Interactions with lost fishing gear around WTG foundations is a potential long-term risk and may be of high intensity, resulting in entanglement, ingestion, injury, and death (Moore and van der Hoop 2012). Exposure level would be considered low due to up to 102 foundations in the WDA, but would pose a long-term risk. As part of the Vineyard Wind 1 Project design, annual monitoring, reporting, and cleanup of fishing gear around the base of the WTGs would be conducted. This would remove any identified fishing gear and reduce the potential for impacts on marine mammals to **negligible** levels.	The risk of impacts from this sub-IPF is proportional to the amount of structure present. The Proposed Action would add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Ongoing entanglement and gear loss/damage at existing structures also periodically results in localized, short-term, **negligible** impacts. Future offshore wind activities, other than the Proposed Action, would add approximately 2,944 acres (12 km^2) of scour/cable protection and the vertical surfaces of up to 2.066 new foundations. Cumulatively, up to 2,066 foundations and 2,944 acres (12 km^2) of scour/cable protection associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would increase the risk of highly localized, periodic, short-term impacts which may be **minor**. Both the Vineyard Wind 1 Project and other future offshore wind development would be expected to contribute to cumulative impacts on marine mammals. The contribution of the maximum of 100 WTGs and 151 acres of scour/cable protection is relatively small when compared to the 2,066 WTGs and 2,944 acres (12 km^2) of scour/ cable protection that are part of the full cumulative impact scenario in the region.
Presence of structures: Habitat conversion and prey aggregation	There are more than 130 artificial reefs in the Mid-Atlantic region. Hard-bottom (scour control and rock mattresses) and vertical structures (bridge foundations and Block Inland Wind Facility WTGs) in a soft-bottom habitat can create artificial reefs, thus inducing the 'reef' effect (Taormina et al. 2018; NMFS 2015). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for seals and small odontocetes compared to the surrounding soft-bottoms.	The presence of structures associated with non-offshore wind development in near shore coastal waters have the potential to provide habitat for seals and small odontocetes as well as preferred prey species. This "reef effect" has the potential to result in long term, low-intensity benefits. Bridge foundations will continue to provide foraging opportunities for seals and small odontocetes with measurable benefits to some individuals. Hard-bottom (scour control and rock mattresses used to bury the offshore export cables) and vertical structures (i.e., WTG and ESP foundations) in a soft-bottom habitat can create artificial reefs, thus inducing the "reef effect" (Taormina et al. 2018; Causon and Gill 2018). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for marine mammals compared to the surrounding soft-bottoms.	Development of the projects in the expanded cumulative scenario would install more buoys, met towers, foundations, and hard protection. Approximately 2,944 acres (12 km^2) of hard protection, and the vertical surfaces of up to 2,066 new foundations can create artificial reefs, thus inducing the 'reef' effect (Taormina et al. 2018; Causon and Gill 2018). Invertebrate and fish assemblages may develop around these reef-like elements within the first year or two after construction (English et al. 2017). Although some studies have noted increased biomass and increased production of particulate organic matter by epifauna growing on submerged foundations, it is not clear to what extent the reef effect results in increased productivity versus simply attracting and aggregating fish from the surrounding areas (Causon and Gill 2018). Recent studies have found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, marine mammals, and birds as well (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019), indicating that offshore wind facilities can generate beneficial permanent impacts on local ecosystems, translating to increased foraging opportunities for marine mammal species compared to the surrounding soft-bottoms.	The Proposed Action is expected to add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations would remain for the life of the Project, and scour/cable protection would likely remain permanently. Foundations may serve as foraging opportunities for seals and small odontocetes. The Proposed Action could also result in increased primary production and zooplankton abundance, which could serve as food for mysticete whales, compared to surrounding locations (Floeter et al. 2017). There may be measurable long-term **minor benefits** from the large number of foundations.	The Proposed Action would add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations may serve as foraging opportunities for seals, small odontocetes and mysticetes, with anticipated long-term **minor benefits** from the large number of foundations. Ongoing and future non-offshore wind activities would be expected to result in similar impacts, but on a smaller geographic scale, and would be limited to nearshore habitat. Future offshore wind development would also be expected to result in similar impacts, but on a larger spatial scale, given the addition of 2,066 structures and 2,944 acres (12 km^2) of hard protection. Cumulatively, these impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be expected to result in long-term **moderate beneficial** impacts on marine mammals due to the large number of structures. However, these beneficial impacts may be masked by impacts resulting from increased interactions with recreational fishing gear (see Presence of structures: Entanglement or ingestion of lost fishing gear sub-IPF above). The contribution of the maximum of 100 WTGs and 151 acres of scour protection is relatively small when compared to the 2,066 WTGs and 2,944 acres (12 km^2) acres of scour/cable protection that are part of the full cumulative impact scenario in the region.
Presence of structures: Avoidance/ displacement	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF. There may be some impacts resulting from the existing Block Island Wind Facility, but given that there are only 5 WTGs, no measurable impacts are occurring.	Not contemplated for non-offshore wind facility sources.	Development of the projects in the expanded cumulative scenario would install more buoys, met towers, and foundations, and hard protection. Under the full buildout scenario, an estimated 2,066 structures would be added to the OCS over a 6- to 10-year period beginning in 2022, and they would remain until decommissioning of each facility is complete (30 years). Although 2,066 structures are anticipated, spacing will be sufficient to allow unobstructed access within wind facilities and between wind facility projects. While avoidance of WDAs due to	The Proposed Action is expected to add up to 102 foundations to the OCS. The proposed spacing between structures is expected to be sufficient to allow unimpeded access within the Project area, but there is a large amount uncertainty around large whale response to offshore wind facilities due to the novelty of this type of development in the Atlantic. Monitoring studies would be able to determine more precisely any changes in whale behavior. However, based on the best available information, none are anticipated. However, long-term, intermittent **minor** impacts on foraging, migratory movements, or other important	The Proposed Action is expected to result in potentially long-term **minor** impacts on marine mammals through this sub-IPF. Though the proposed spacing between structures would be sufficient to allow unimpeded access within the Proposed Action area, but impacts on foraging, migratory movements, or other important behaviors may occur as a result of the Proposed Action. Ongoing and future non-offshore wind activities would not be expected to result in any impact on marine mammals. Future offshore wind activities would be expected to result in similar impacts, but over a greater spatial and temporal scale. However, the proposed spacing between structures would be sufficient to allow unimpeded access between offshore wind facilities and between individual WTGs. Cumulatively, impacts related to avoidance/displacement associated with the

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			new structures is possible, it is unlikely due to the whales' size relative to turbine spacing. However, there is some uncertainty with the prediction of whales' behavior related to turbine presence due to the novelty of this type of development in the Atlantic. Monitoring studies would be able to determine more precisely any changes in whale behavior.	behaviors may occur as a result of the Proposed Action. However, temporary displacement from the WDA during Project construction into areas with higher risk of interactions with fishing and commercial vessels (see increased vessel traffic below) may also occur.	Proposed Action when combined with past, present, and reasonably foreseeable activities as a result of 2,066 new, novel structures on the OCS would be expected to be **minor** to **moderate**. However, additional impacts may occur if individuals are displaced into areas with higher risk of vessel and/or fisheries interactions (see Traffic: Vessel collisions below).
Presence of structures: Behavioral disruption - breeding and migration	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.	Although 2,066 structures are anticipated, spacing will be sufficient to allow unimpeded access within wind facilities and between wind facility projects. However, there is some uncertainty with the prediction of whales' behavior related to turbine presence due to the novelty of this type of development in the Atlantic. Monitoring studies would be able to determine more precisely any changes in whale behavior. However, based on the best available information, none are anticipated. However, it is important to acknowledge some uncertainty that the cumulative impacts several wind facilities along the Atlantic coast may have on large whales that migrate along these routes. Therefore, due to uncertainty and lack of information on the migratory impacts of wind facilities on large whales, some behavioral impacts may be expected under the cumulative scenario that are expected to be moderate in intensity, have moderate exposure level, and be long-term.	It is not likely that whales would avoid the Project Area during seasonal migrations due to the whales' size relative to turbine spacing. However, there is some uncertainty with the prediction of whales' behavior related to turbine presence due to the novelty of this type of development in the Atlantic. Monitoring studies would be able to determine more precisely any changes in whale behavior. However, based on the best available information, non-measurable, **negligible** impacts, if any, are anticipated.	Although an estimated 2,066 new foundations, are anticipated, spacing would be sufficient to allow unimpeded access within the Proposed Action, and **negligible** impacts, if any, would be expected. No ongoing or non-offshore wind activities would contribute to this sub-IPF. Future offshore wind development would be expected to result in similar impacts, but over a greater geographic extent. Cumulatively, due to uncertainty and lack of information on the migratory impacts of wind facilities (e.g., WTG presence or operational noise) on large whales, some behavioral impacts may be expected under the cumulative scenario. Potential **minor** impacts on foraging, migratory movements, or other important behaviors may occur as a result of the Proposed Action as well as other future offshore wind development, as described above. Additionally, temporary displacement from the WDA during Project construction into areas with higher risk of interactions with fishing and commercial vessels (see increased vessel traffic below) may also contribute to cumulative impacts on marine mammals.
Presence of structures: Displacement into higher risk areas (Vessels and Fishing)	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.	Although construction activities would likely temporarily displace animals into areas that have a higher risk of interactions with ships or fishing gear, the operational phase may or may not result in any displacement. The 1-nautical mile grid spacing and low operational noise levels allow unobstructed access to habitat in wind facility areas. However, due to uncertainty and lack of information on the impacts of wind facilities on large whales, some displacement may occur. The risk of displacement from WDAs would be widespread and present for long periods over the life of a lease. If marine mammals avoid the Vineyard Wind 1 Project area, during construction, they may be at increased risk of interactions with potentially high vessel traffic including fisheries vessels and fisheries gear (Sections 3.11, and 3.13).	If marine mammals avoid the Vineyard Wind 1 Project area, during construction, they may be at increased risk of interactions with potentially high vessel traffic including fisheries vessels and fisheries gear (Sections 3.11 and 3.13). Given that vessel strike is relatively common with cetaceans (Kraus et al. 2005) and one of the primary causes of death to NARWs, displacement due to the presence of structures may result in **moderate** impacts on marine mammals during construction. If individuals are displaced from the Project area permanently, these impacts would last for the life of the Project (30 years). Monitoring studies would be able to determine more precisely any changes in whale behavior and use of the Project during construction and operations.	The Proposed Action has the potential to result in **moderate** temporary impacts on marine mammals due to displacement from the Project area, potentially increasing the potential for fatal interactions with vessels and fisheries gear. No ongoing or non-offshore wind activities would contribute to this sub-IPF. Future offshore wind development would be expected to result in similar impacts, but over a greater geographic extent. Cumulatively, the expected **moderate** temporary impacts associated with displacement form the lease areas would not be expected to result in stock-level impacts because no critical habitat or feeding hotspots have been identified within the lease areas. However these moderate cumulative impacts have some potential to persist over the course of a project's life if the displacement is permanent. The contribution of the maximum of 100 WTGs is relatively small when compared to the 2,066 that are part of the full cumulative impact scenario in the region.
Traffic: Vessel collisions	Current activities that are contributing to this sub-IPF include port traffic levels, fairways, traffic separation schemes, commercial vessel traffic, recreational and fishing activity, and scientific and academic vessel traffic. Vessel strike is relatively common with cetaceans (Kraus et al. 2005) and one of the primary causes of death to NARWs with as many as 75% of known anthropogenic mortalities of NARWs likely resulting from collisions with large ships along the US and Canadian eastern seaboard (Kite-Powell et al. 2007). Marine mammals are more vulnerable to vessel strike when they are within the draft of the vessel and when they are beneath the surface and not detectable by visual observers. Some conditions that make marine mammals less detectable include weather conditions with poor visibility (e.g., fog, rain, and wave height) or nighttime operations. Vessels operating at speeds exceeding 10 knots have been associated with the highest risk for vessel strikes of NARWs (Vanderlaan and Taggart 2007). Reported vessel collisions with whales show that serious injury rarely occurs at speeds below 10 knots (Laist et al. 2001). Data show that the probability	Vessel traffic associated with non-offshore wind development has the potential to result in an increased collision risk. While these impacts would be high consequence, the patchy distribution of marine mammals makes stock or population-level effects unlikely (Navy 2018).	As described in BOEM 2019b, offshore wind will result in a small incremental increase in vessel traffic volume relative to ongoing and future non-offshore wind activities. At the peak of project construction from 2022 to 2023 up to 230 vessels associated with offshore wind development along the east coast may be operating in the marine mammal geographic analysis area. However, this vessel traffic increase would be expected to result in only a small incremental increase in overall vessel traffic within the geographic analysis area for marine mammals. This increased collision risk has the potential to result in injury or mortality to individuals, but would not be expected to have stock or population-level impacts on marine mammals given their patchy distribution within the geographic analysis area. Further, implementation of the following BMP (Appendix A Table A-5) would reduce the potential for impacts relative to this sub-IPF during offshore wind development: Vessels related to project planning, construction, and operation must travel at reduced speeds when assemblages of cetaceans are observed and maintain a reasonable distance from whales, small cetaceans, and sea turtles as determined during site-specific consultations.	The increase in vessel traffic associated with the Vineyard Wind 1 Project would be greatest during construction, with an estimated maximum of 46 vessels operating in the WDA daily. Given the mobility of marine mammals, the use of PSO, PAM, and mitigation measures Vineyard Wind has voluntarily committed to implementing such as vessel speed restrictions, interactions with Vineyard Wind vessels and marine mammals would not be expected to occur. Although vessel strike is among the leading sources of human-caused whale mortalities, several factors reduce the probability of a Project-related strike. The Project will have a period of peak vessel activity lasting approximately 2 years (during construction), when an average of approximately seven vessel trips per day will occur. In the context of regional vessel traffic, Project-related vessel activity will add a relatively moderate, but temporary increase in vessel traffic to the region. The majority of Project vessel traffic will occur within the Project area (WDA, OECC), and vessel transit corridors to New Bedford and Vineyard Haven, where marine mammal densities are relatively low in comparison to the overall region.	While some increase in vessel traffic associated with the Vineyard Wind 1 Project would occur, the incremental increase would be very small relative to current vessel traffic in the area. Further, implementation of project-specific measures, including the use of PSO, PAM, and vessel speed restrictions, impacts on marine mammals through this sub-IPF would be expected to be **negligible**. Ongoing and future non-offshore wind activities have the potential to result in marine mammal mortality throughout the marine mammal geographic analysis area, though impacts would be concentrated in shipping lanes and other areas regularly traversed by vessels (Table 3.13-1 on navigation). Future offshore wind activities may also pose a significant risk to marine mammals through this sub-IPF, particularly if BOEM and NMFS measures are not included. Cumulatively, impacts related to vessel collisions associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be expected to be **minor to moderate**. Future offshore wind development would contribute only a small portion of the overall vessel traffic in the region (BOEM 2019b). The relative risk of vessel strikes from wind industry vessels is dependent upon the stage of development, time of year, number of vessels, and speed of vessels during each stage.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	of a vessel strike increases with the velocity of a vessel (Pace and Silber 2005; Vanderlaan and Taggart 2007).				
Climate change: Warming and sea level rise, storm severity/ frequency	Increased storm frequency could result in increased energetic costs for marine mammals and reduced fitness, particularly for juveniles, calves and pups.	No future activities were identified within the geographic analysis area for marine mammals other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to increased energetic costs and reduced fitness of individual marine mammals. Because this sub-IPF is a global phenomenon, impacts on marine mammals though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change.
Climate change: Ocean acidification	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine ecosystems by contributing to reduced growth or the decline of invertebrates that have calcareous shells.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to reduced growth or the decline of some marine mammal prey species. Because this sub-IPF is a global phenomenon, impacts on marine mammals though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change.
Climate change: Warming and sea level rise, altered habitat/ecology	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine mammals as a result of changes in distribution, reduced breeding, and/or foraging habitat availability, and disruptions in migration.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to changes in the distribution and availability of breeding and/or foraging habitat as well as disruption in migration. Because this sub-IPF is a global phenomenon, impacts on marine mammals though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change.
Climate change: Warming and sea level rise, altered migration patterns	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine mammal habitat use and migratory patterns. For example, the NARW appears to be migrating differently and feeding in different areas in response to changes in prey densities related to climate change (Record et al. 2019; MacLeod 2009; Nunny and Simmonds 2019.)	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to changes in habitat use and seasonal migration timing and patters. Because this sub-IPF is a global phenomenon, impacts on marine mammals though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change.
Climate change: Warming and sea level rise, increased disease frequency	Climate change, influenced in part by greenhouse gas emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the frequencies of various diseases of marine mammals, such as Phocine distemper. Climate change is clearly influencing infectious disease dynamics in the marine environment; however, no studies have shown a definitive causal relationship between any components of climate change and increases in infectious disease among marine mammals. This is due in large part to a lack of sufficient data and to the likely indirect nature of climate change's impact on these diseases. Climate change could potentially affect the incidence or prevalence of infection, the frequency or magnitude of epizootics, and/or the severity or presence of clinical disease in infected individuals. There are a number of potential proposed mechanisms by which this might occur (see summary in Burge et al. 2014 Climate Change Influences on Marine Infectious Diseases: Implications for Management and Society).	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to the incidence, prevalence, and severity of diseases in marine mammal populations. Because this sub-IPF is a global phenomenon, impacts on marine mammals though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change.
Climate change: Warming and sea level rise, storm severity/frequency, sediment erosion, deposition	Increased storm frequency could result in increased energetic costs for marine mammals, reduced fitness, particularly for juveniles, calves and pups. Erosion could impact seal haul outs reducing their habitat availability, especially as things like sea walls are added, blocking seals access to shore.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to impacts on terrestrial pinniped haul out areas, potentially altering or eliminating currently suitable habitat. Because this sub-IPF is a global phenomenon, impacts on marine mammals though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change.

μPa = micropascal; μT = microtesla; AC = alternating current; BA = Biological Assessment; BOEM = Bureau of Ocean Energy Management; BMP = best management practice; BSW = Bay State Wind; CFR = Code of Federal Regulations; COP = Construction and Operations Plan; dB = decibel; dB RMS = decibel root mean square; DP = dynamic positioning; EIS = Environmental Impact Statement; EMF = electromagnetic field; FCC = Federal Communications Commission; G&G = Geological and Geophysical; hazmat = hazardous material; HRG = High Resolution Geophysical; Hz = hertz; IHA = Incidental Harassment Authorization; IPF = impact-producing factors; km^2 = square kilometers; m^2 = square meters; met – meteorological; mg/L = milligrams per liter; MW = megawatt; NARW = North Atlantic right whale; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor; PAM = passive acoustic monitoring; PSO = protected species observer; PTS = permanent threshold shift; SOV = service operations vessel; TTS = temporary threshold shift; USCG = U.S. Coast Guard; WDA = Wind Development Area; WTG = wind turbine generator

Table 3.5-2: Maximum Number of Potential Concurrent Pile-driving Days on Neighboring Projects under the Cumulative Impact Scenario (not including the Proposed Project)

Construction Year	1 Foundation per Day (2 Foundations per Day)					
	Maine	Massachusetts/ Rhode Island	New York/ New Jersey	Delaware/ Maryland	Virginia	Annual Total
2021	0	16 (8)	0	0	0	16 (8)
2022	0	90 (45)	0	11 (6)	0	101 (51)
2023	0	103 (52)	0	0	0	103 (52)
2024	0	0	0	0	0	0
2025	0	68 (34)	0	0	0	68 (34)
2026	0	0	0	0	0	0
2027	0	0	0	0	0	0
2028	0	0	0	0	0	0
2029	0	0	0	0	0	0
2030+	0	0	0	0	0	0

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Table 3.6-1: Summary of Activities and the Associated Impact-Producing Factors for Sea Turtles

Baseline Conditions: Sea turtles are wide-ranging and long-lived, making population estimates difficult (TEWG 2007; NMFS and USFWS 2013; NMFS and USFWS 2015). Further details are provided in the Draft EIS Section 3.3.8.1, Current Condition and Trend.

Leatherback (*Dermochelys coriacea*): The population estimate (total number of adults) in the Atlantic is 34,000 to 94,000 (NMFS and USFWS 2013; TEWG 2007). Aside from the western Caribbean, nesting trends at all other Atlantic nesting sites are generally stable or increasing (NMFS and USFWS 2013; TEWG 2007).

Loggerhead (*Caretta caretta*): Regional abundance estimate in the Northwest Atlantic Continental Shelf in 2010 was approximately 588,000 individuals (NEFSC and SEFSC 2011b).

The three largest nesting subpopulations responsible for most of the production in the western North Atlantic (Peninsular Florida, Northern United States, and Quintana Roo, Mexico) have all been declining since at least the late 1990s, thus indicating a downward trend for this population (TEWG 2009).

Kemp's ridley (*Lepidochelys kempii*): The population was severely decimated in 1985, due to intensive egg collection and fishery bycatch, with only 702 nests counted during the entire year (NMFS and USFWS 2015; Bevan et al. 2016). Recent estimates of the total population of age 2 years and older is 248,307; however, recent models indicate a persistent reduction in survival and/or recruitment to the nesting population suggesting that the population is not recovering to historical levels (NMFS and USFWS 2015).

North Atlantic DPS of green sea turtle (*Chelonia mydas*): The primary nesting beaches are Costa Rica, Mexico, United States (Florida), and Cuba. The most recent status review for the DPS estimates the number of female nesting turtles to be approximately 167,424 individuals (NMFS 2015). According to NMFS and USFWS (2014), nesting trends are generally increasing for this DPS.

Regional, pre-existing threats to sea turtles include entanglement in fisheries gear, fisheries bycatch, and vessel strike. In addition, loggerhead, Kemp's ridley, and green sea turtles are susceptible to cold stunning. Commercial fisheries occurring in the southeastern New England region include bottom trawl, midwater trawl, dredge, gillnet, longline, and pots and traps (COP Section 7.8, Volume III; Epsilon 2018a). Commercial vessel traffic in the region is variable depending on location and vessel type. The commercial vessel types and relative density in the Project region during 2013 include cargo (low), passenger (high), tug-tow (high), and tanker (low; Epsilon 2018a).

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
Accidental releases: Fuel/fluids/hazmat	See Appendix A Table A-8 for a quantitative analysis of these risks. Ongoing releases are frequent and chronic. Sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka et al. 2010) or sublethal effects on individual fitness, including adrenal effects, dehydration, hematological effects, increased disease incidence, liver effects, poor body condition, skin effects, skeletomuscular effects, and several other health effects that can be attributed to oil exposure (Camacho et al. 2013; Bembenek-Bailey et al. 2019; Mitchelmore et al. 2017; Shigenaka et al. 2010; Vargo et al. 1986). Additionally, accidental releases may result in impacts on sea turtles due to effects on prey species (Table 3.4-1).	See Appendix A Table A-8 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. Sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka 2010; Wallace et al. 2010) or sublethal effects on individual fitness, including adrenal effects, dehydration, hematological effects, increased disease incidence, liver effects, poor body condition, skin effects, skeletomuscular effects, and several other health effects that can be attributed to oil exposure (Camacho et al. 2013; Bembenek-Bailey et al. 2019; Mitchelmore et al. 2017; Shigenaka et al. 2010; Vargo et al. 1986). Additionally, accidental releases may result in impacts on sea turtles due to effects on prey species (Table 3.4-1).	Similar to future non-offshore wind activities, accidental releases from offshore vessel usage, spills, and releases associated with vessel traffic resulting from future offshore wind development will likely continue on a similar trend as described under Ongoing Activities. Impacts resulting from accidental releases may pose a long-term risk to sea turtles and could potentially lead to mortality and sublethal impacts on individuals present in the vicinity of the spill, but the potential for exposure would be limited given the isolated nature of these accidental releases and the patchy distribution of sea turtles in the geographic analysis area.	Given that vessel discharges would be limited to uncontaminated or treated liquids, impacts on water quality, and thus to sea turtles, would not be expected to occur. As described in the Draft EIS, the mostly likely type of accidental release of hazardous materials would range from 90 to 440 gallons (Bejarano 2013) and result in localized, temporary **negligible** impacts on sea turtles. Impacts on individual sea turtles, including decreased fitness, health effects, and mortality, may occur, if present in the vicinity of the spill, but accidental releases are expected to be rare, and injury or mortality would not be expected to occur. Further, all vessels associated with the Proposed Action would comply with the USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize effects on sea turtles resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012).	See Appendix A Table A-8 on water quality for a quantitative analysis of these risks. The Proposed Action could lead to an increased potential for a release that may result in localized and temporary **negligible** impacts, including individual mortality, decreased individual fitness, and health effects. However, all vessels associated with the Proposed Action would comply with the USCG requirements for the prevention and control of oil and fuel spills minimizing effects on sea turtles resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012). The impacts from ongoing activities and future non-offshore wind activities stem from the increased potential for releases over the next 30 years due to increasing vessel traffic and ongoing releases, which are frequent/chronic. Future offshore wind activities would contribute to an increased risk of spills and impacts on sea turtles, including mortality, health effects, and decreased fitness due to fuel/fluid/hazmat exposure. The contribution from future offshore wind and the Proposed Action would be a low percentage of the overall spill risk from ongoing activities. Cumulatively, the impacts on sea turtles from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be localized, temporary, and **negligible** due to the likely limited extent and duration of a release, described in detail in the Draft EIS Section 3.2.2.3) on Water Quality.
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities, cables, lines, and pipeline laying, as well as debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Direct ingestion of plastic fragments is well documented and has been observed in all species of sea turtles (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016; Schuylar et al. 2014). In addition to plastic debris, ingestion of tar, paper, Styrofoam™, wood, reed, feathers, hooks, lines, and net fragments have also been documented (Thomás et al. 2002). Ingestion can also occur when individuals mistake debris for potential prey items (Gregory 2009; Hoarau et al. 2014; Thomás et al. 2002). Potential ingestion of marine debris varies among species and life history stages due to differing feeding strategies (Nelms et al. 2016). Ingestion of plastics and other marine debris can result in both lethal and sublethal impacts on sea turtles, with sublethal effects more difficult to detect (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Long-term sublethal effects may include dietary dilution, chemical contamination, depressed immune system function,	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying, and debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Direct and indirect ingestion of plastic fragments and other marine debris is well documented and has been observed in all species of sea turtles (Bugoni et al. 2001; Gregory 2009; Hoarau et al. 2014; Nelms et al. 2016; Schuylar et al. 2014;Thomás et al. 2002). Ingestion can result in both lethal and sublethal impacts on sea turtles, with sublethal effects more difficult to detect (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). However, these effects are cryptic and	Trash and debris may be released by vessels associated with offshore wind development during construction, operations and decommissioning. BOEM assumes operator compliance with federal and international requirements for managing shipboard trash; such events also have a relatively limited spatial impact. While precautions to prevent accidental releases will be employed by vessels and port operations associated with future offshore wind development, it is likely that some debris could be lost overboard during construction, maintenance, and decommissioning activities. However, the amount would likely be miniscule compared to other inputs. In the event of a release, it would be an accidental, low-probability event in the vicinity of Project areas.	Trash and debris may be released by Project vessels during construction, operations, and decommissioning. BOEM assumes operator compliance with federal and international requirements for managing shipboard trash; such events also have a relatively limited spatial impact. While precautions to prevent accidental releases would be employed by vessels and port operations associated with Vineyard Wind 1 Project, it is likely that some debris could be lost overboard during construction, maintenance and routine vessel activities. However, the amount would likely be miniscule compared to other inputs. In the event of a release, it would be an accidental, localized event in the vicinity of Project areas, likely resulting in non-measurable **negligible** impacts, if any. Further, proposed BMPs for waste management and mitigation as well as marine debris awareness and elimination training for Vineyard Wind 1 Project personnel would be required, reducing the likelihood of an accidental release.	The Proposed Action could lead to non-measurable **negligible** impacts on sea turtles, ranging from decreased fitness to mortality. However, proposed BMPs for waste management and mitigation, and marine debris training and awareness for Project personnel would be required, which would reduce the likelihood of occurrence to a very low risk. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature, but would involve a greater spatial and temporal extent. Future offshore wind activities would likely result in much more accidental trash and debris releases relative to the Proposed Action, but the overall risk would still be considered low. Cumulatively, the expected **negligible** impacts on sea turtles through this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be localized and short-term, with the Proposed Action having little to no influence on cumulative impacts through this sub-IPF.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
	poor body condition, as well as reduced growth rates, fecundity, and reproductive success. However, these effects are cryptic and clear causal links are difficult to identify (Nelms et al. 2016).	clear causal links are difficult to identify (Nelms et al. 2016).			
EMF	EMFs emanate constantly from installed telecommunication and electrical power transmission cables. In the geographic analysis area, there are six existing power cables connecting Martha's Vineyard and Nantucket to the mainland. Sea turtles appear to have a detection threshold of magnetosensitivity and behavioral responses to field intensities ranging from 0.0047 to 4000 µT for loggerhead turtles, and 29.3 to 200 µT for green turtles, with other species likely similar due to anatomical, behavioral, and life history similarities (Normandeau et al. 2011). Juvenile or adult sea turtles foraging on benthic organisms may be able to detect magnetic fields while they are foraging on the bottom near the cables and up to potentially 82 feet (25 meters) in the water column above the cable. Juvenile and adult sea turtles may detect the EMF over relatively small areas near cables (e.g., when resting on the bottom or foraging on benthic organisms near cables or concrete mattresses). There are no data on impacts on sea turtles from EMFs generated by underwater cables, although anthropogenic magnetic fields can influence migratory deviations (Luschi et al. 2007; Snoek et al. 2016). However, any potential impacts from AC cables on turtle navigation or orientation would likely be undetectable under natural conditions, and thus would be insignificant (Normandeau et al. 2011).	During operations, future new cables would produce EMF. Submarine power cables in the geographic analysis area for sea turtles are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. (Section 5.2.7 of BOEM's 2007 Final Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf.) EMF of any two sources would not overlap. Although the EMF would exist as long as a cable was in operation, impacts, if any, would likely be difficult to detect, if they occur at all. Further, this IPF would be limited to extremely small portions of the areas used by resident or migrating sea turtles. As such, exposure to this IPF would be low, and as a result, impacts on sea turtles would not be expected.	In the expanded cumulative scenario, up to 5,947 miles (9,571 km^2) of cable would be added in the geographic analysis area for sea turtles, producing EMF in the immediate vicinity of each cable during operations. Sea turtles have the potential to react to submarine cable EMF; however, impacts, if any, would likely be difficult to detect, if they occur at all. Further, this IPF would be limited to extremely small portions of the areas used by resident or migrating sea turtles. As such, exposure to this IPF would be low, and as a result, impacts on sea turtles would not be expected.	EMF would emanate from any active cable during operations. The proposed shielding and burial depths would minimize EMF intensity and extent. Given the extremely small area where exposure to this IPF would occur and the proposed burial depth of the submarine cable, no measurable impacts such as changes in swimming direction and altered migration routes would be expected. These effects on sea turtles are more likely to occur with DC cables than with AC cables (Normandeau et al. 2011). Because AC cables have been proposed for the Vineyard Wind 1 Project and the Project area represents an extremely small area within the coastal waters used by migrating sea turtles, BOEM expects non-measurable **negligible** impacts, if any, on migratory behavior of sea turtles.	The Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on sea turtles through this IPF due to the localized nature of EMF along Project cables near the seafloor, the wide ranges of sea turtles, and the appropriate shielding and burial depth. Ongoing and future non-offshore wind activities may have similar effects. Future offshore wind activities would likely result in the same type of impacts, but with a greater spatial extent than ongoing activities. Cumulatively, the expected **negligible** impacts on sea turtles through this IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be long-term, but highly localized, with the Proposed Action having little to no influence on cumulative impacts through this IPF.
Light: Vessels	Ocean vessels such as ongoing commercial vessel traffic, recreational and fishing activity, scientific and academic research traffic have an array of lights including navigational, deck lights, and interior lights. Such lights have some limited potential to attract sea turtles, although the impacts, if any, are expected to be localized and temporary.	Construction, operations, and decommissioning vessels associated with non-offshore wind activities produce temporary and localized light sources that could result in the attraction or avoidance behavior of sea turtles. These short-term impacts are expected to be of low intensity and occur infrequently.	Similar to non-offshore wind activities, vessel traffic associated with project construction, operations, and decommissioning would be expected to result in short-term, intermittent impacts, but would not be expected to measurably contribute to this sub-IPF.	Like future offshore wind development, vessel traffic associated with the proposed Vineyard Wind 1 Project may result in some behavioral responses. These impacts, if any, would be expected to be **negligible**, as any responses to passing vessels would be short-term, temporary, and dissipate once the vessel or turtle has left the area.	The Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on sea turtles through this sub-IPF due to the localized, short-term, and temporary nature of the impacts. Future activities, including both non-offshore wind and offshore wind activities would be expected to result in similar impacts. Cumulatively, the expected **negligible** impacts on sea turtles through this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be short-term and localized, with the Proposed Action having little to no influence on cumulative impacts through this sub-IPF.
Light: Structures	Artificial lighting on nesting beaches or in nearshore habitats has the potential to result in disorientation to nesting females and hatchling turtles. Artificial lighting on the OCS does not appear to have the same potential for effects. Decades of oil and gas platform operation in the Gulf of Mexico, that can have considerably more lighting than offshore WTGs, has not resulted in any known impacts on sea turtles (BOEM 2019a).	Non-offshore wind activities would not be expected to appreciably contribute to this sub-IPF. As such, no impact on sea turtles would be expected.	BOEM assumes that offshore wind projects will be sited offshore, away from nesting beaches and would not disorientate nesting females or hatchling sea turtles. Up to 2,021 turbines and 45 ESPs would be constructed incrementally over time, beginning in 2022 and continuing through 2030, on the OCS where few lighted structures currently exist. These would have minimal yellow flashing navigational lighting and red flashing FAA hazard lighting in accordance with BOEM's (2019c) lighting and marking guidelines which would not present a continuous light source and would not be expected to result in disorientation of adults or juvenile sea turtles (Orr et al. 2013). Although some turtles could possibly be temporarily attracted to WTGs, the potential effects to sea turtles from lighting would not be expected to result in individual fitness or population level effects.	The Proposed Action's incremental contribution would be lighting of up to 100 WTGs and two ESPs, all of which would be lit with navigational and FAA hazard lighting. Per BOEM guidance (2019c) and outlined in the COP Section 3.1.1 (Volume I; Epsilon 2018a) each WTG would be lit with two FAA "L-864" aviation red flashing obstruction lights on top of the nacelle, adding up to 200 new red flashing lights. Additionally, marine navigation lighting would consist of multiple flashing yellow lights on each WTG and on the corners of each ESP. Orr et al. (2013) indicated that lights on WTGs that flash, i.e., do not present a continuous light source, do not appear to cause disorientation in adult and juvenile sea turtles. Based on the best available information, the potential attraction of sea turtles to WTG lighting is anticipated to result in **negligible** impacts, if any, on individual sea turtles. Further, the Vineyard Wind 1 Project would use the ADLS, which would reduce the use of FAA lighting to approximately 10% of the time.	The Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on sea turtles through this sub-IPF due to the distance from nesting beaches and the current apparent lack of any known impacts. Future offshore wind activities would be expected to result in similar impacts, but over a greater spatial extent. Cumulatively, the expected **negligible** impacts, if any, on sea turtles through this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are not expected.
New cable emplacement/ maintenance	Cable maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be local and generally limited to the emplacement corridor. Data are not available regarding effects of suspended sediments on adult and juvenile sea turtles, although elevated suspended sediments may cause individuals to alter normal movements and behaviors. However, these changes are expected to be too small to be detected (NOAA 2020). Sea turtles would be expected to swim away from the sediment plume. Elevated turbidity is most likely to affect sea turtles if a plume causes a barrier to normal behaviors, but no	The FCC has two pending submarine telecommunication cable application in the North Atlantic. The impact on water quality from accidental sediment suspension during cable emplacement is short-term and temporary. If elevated turbidity caused any behavioral responses such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any impacts would be short-term and temporary. Turbidity	Future offshore wind development will require new cabling to bring generated electricity onshore, and would result in sea floor disturbance and elevated levels of suspended sediment. Assuming similar installation procedures as the proposed Project, the duration and range of impacts would be limited. Impacts would occur during construction and would involve increased turbidity for 1 to 6 hours at a time. Short-term impacts on individual sea turtles could occur in the immediate vicinity of installation activities. The total area of direct seafloor disturbance is	Installation of submarine cable would mostly be done by jet or mechanical plow. The Proposed Action's incremental contribution of up to 328 acres (1.3 km^2) of seafloor disturbance by cable installation and up to 69 acres (0.3 km^2) affected by dredging prior to cable installation would result in turbidity effects that have the potential to have temporary **minor to moderate** impacts on some sea turtle prey species, including benthic mollusks, crustaceans, sponges, sea pens, and crabs. The modeled resultant plume is predicted to stay in the lower portion of the water column	The Proposed Action estimated that up to 328 acres (1.3 km^2) of sea floor could be disturbed by cable installation and that up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation, potentially leading to short-term **negligible** impacts on sea turtles due to displacement, although no biologically significant impacts would be expected. Ongoing and future non-offshore wind activities may cause similar local, short-term impacts. Future offshore wind activities other than the proposed Project would disturb up to 8,156 acres (33.0 km^2), though similar localized, short-term impacts would not be expected to be biologically significant. No measurable

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
	impacts would be expected due to swimming through the plume (NOAA 2020). Turbidity associated with increased sedimentation may result in short-term, temporary impacts on sea turtle prey species (Table 3.4-1).	associated with increased sedimentation may result in short-term, temporary impacts on some sea turtle prey species (Table 3.4-1).	estimated to be up to 8,156 acres (33.0 km²). These disturbances will be local and generally limited to the emplacement corridor. Further, suspended sediment concentrations in Nantucket Sound under natural conditions are 45-71 mg/L. Suspended sediment concentrations due to jet plow are within the range of natural variability for this area. The impact on water quality from sediment suspension during cable laying activities would be short-term and temporary. If elevated turbidity caused any behavioral responses such as avoiding the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any impacts would be short-term and temporary. Turbidity associated with increased sedimentation may result in short-term, temporary impacts on some sea turtle prey species (Table 3.4-1).	(bottom 9.8 feet). The portion of the plume that exceeds 10 mg/L typically would extend 656 feet from the route centerline but could extend up to 1.2 miles. Modeling showed sediment concentrations greater than 10 mg/L from dredging could extend up to 10 miles (16 kilometers) from the route centerline and spread through the entire water column. These plumes typically settled within 3 hours but could persist in small areas (15 acres [60,702.8 m²] or less) for up to 6 to 12 hours (Epsilon 2018c). Dredged material disposal could cause concentrations greater than 1,000 mg/L for a duration of less than 2 hours and a distance of approximately 3 miles (5 kilometers). For this reason, Vineyard Wind expects to use dredging only when necessary in sand wave areas, and not at all within Lewis Bay. A predicted maximum of 3.8 miles (6.1 kilometers) of dredging may occur in the OECC (Table 1-5 in Epsilon 2018a). Attachment C of Epsilon 2018a depicts potential areas of discontinuous dredging. Although turbidity is likely to be high in the affected areas, the sediment no longer affects water quality once it has settled. If elevated turbidity caused any behavioral responses such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary, only occurring for less than 2 to 6 hours per day from April through October (Vineyard Wind 2018a), and any impacts would be short-term and temporary. Because the period of sediment suspension is very short-term and localized and the use of dredging is restricted, non-measurable **negligible** impacts, if any, would be expected.	cumulative impacts on sea turtles would be attributed to the Proposed Action. Some non-measurable **negligible** cumulative impacts arising from future development, including future offshore wind could occur if impacts occur in close temporal and spatial proximity; however, these impacts would not be expected to be biologically significant (NOAA 2020).
Noise: Aircraft	Aircraft routinely travel in the geographic analysis area for sea turtles. With the possible exception of rescue operations, no ongoing aircraft flights would occur at altitudes that would elicit a response from sea turtles. If flights are at a sufficiently low altitude, sea turtles may respond with a startle response (diving or swimming away), altered submergence patterns, and a temporary stress response (NSF and USGS 2011; Samuel et al. 2005). These brief responses would be expected to dissipate once the aircraft has left the area.	Future low altitude aircraft activities such as survey activities and navy training operations could result in short-term responses of sea turtles to aircraft noise. If flights are at a sufficiently low altitude, sea turtles may respond with a startle response (diving or swimming away), altered submergence patterns, and a temporary stress response (NSF and USGS 2011; Samuel et al. 2005). These brief responses would be expected to dissipate once the aircraft has left the area.	Future offshore wind development may require the use of helicopters to supplement crew transport during construction and operations. BOEM expects that helicopters transiting to the offshore WDAs would fly at altitudes above those that would cause behavioral responses from sea turtles except when flying low to inspect WTGs, or take off and land on the Service Operation Vessel (SOV). While helicopter traffic may cause some short-term and temporary behavioral reactions in sea turtles while helicopters move to a safe distance, BOEM does not expect this activity to cause injury.	Vineyard Wind may use helicopters to supplement crew transport and for Proposed Action support during both construction and operations (COP Section 4.2.4, Volume I; Epsilon 2018a), which may cause behavioral changes to sea turtles, if present in the vicinity. Aircraft operations may ensonify areas, albeit for short periods at any one location while in transit. BOEM expects that helicopters transiting to the Project area would fly at altitudes above those that would cause behavioral responses from sea turtles except when flying low to inspect WTGs, or to take off and land on the SOV. While helicopter traffic may cause some short-term and **negligible** behavioral reactions in sea turtles while helicopters move to a safe distance, BOEM expects these impacts, if any, to be short-term, temporary and **negligible,** resulting in minimal energy expenditure.	The Proposed Action may result in non-measurable **negligible** behavioral responses, including startle responses (diving or swimming away), altered submergence patterns, or temporary stress responses through this sub-IPF. Aircraft operations associated with the Vineyard Wind 1 Project are not expected to occur in great numbers, but could possibly occur during operations and mitigation-related surveys during construction. Impacts resulting from ongoing and future offshore development would be limited to rescue operations and would be expected to result in similar impacts on sea turtles. Future offshore wind activities would likely result in much more aircraft flights than the Proposed Action, but the overall impacts on individuals would still be considered low, and non-biologically significant impacts would be expected. Cumulatively, the impacts on sea turtles through this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be short-term and localized, with non-biologically significant **negligible** impacts expected to result. The Proposed Action would have little to no influence on cumulative impacts through this sub-IPF.
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities have the potential to result in some impacts including potential auditory injuries, short-term disturbance, behavioral responses, and short-term displacement of feeding or migrating leatherback sea turtles and possibly loggerheads, if present within the ensonified area (NSF and USGS 2011). The potential for PTS and TTS is considered possible in proximity to G&G surveys, but impacts are unlikely as turtles would be expected to avoid such exposure and survey vessels would pass quickly (NSF and USGS 2011). No significant impacts would be expected at the population level.	Same as ongoing activities, with the addition of possible future oil and gas exploration surveys.	Site characterization surveys for offshore wind facilities would create intermittent, high-intensity impulsive noise around sites of investigation over a 2- to 10-year period. Sound sources used during G&G activities have the potential to produce potential auditory injuries, although considered unlikely, as well as short-term disturbance, behavioral responses, and short-term displacement of feeding or migrating leatherback sea turtles and possibly loggerheads, if present within the ensonified area (NSF and USGS 2011). Seismic surveys can extend over a time scale of months, as does construction and installation of offshore wind structures. However, identifying the locations and schedules of offshore wind G&G and construction or installation activities could avoid	Noise from G&G surveys during inspection and/or monitoring of cable routes may occur during construction and operations. Higher frequency HRG survey noise resulting from cable route surveys may be less intense than G&G noise from site investigation surveys in WDAs. Due to the higher frequency, a few HRG sources (sub-bottom profilers, boomers, and sparkers) may be detectable by sea turtles (BOEM 2018); however, **negligible** impacts, if any would be expected as turtles would be expected to avoid exposure and survey vessels would pass quickly (NSF and USGS 2011). Additionally, because HRG surveys are lower energy and operate in smaller areas, the associated ensonified area is smaller; however, impacts on sea turtles could occur at close	G&G survey noise from the Proposed Action may result in temporary **negligible** impacts, including non-biologically significant behavioral and physiological effects along the cable routes during inspection. Ongoing and future non-offshore wind impacts may result in similar types of impacts over an unknown extent. Future offshore wind activities, other than the proposed Project, would likely affect a much greater area than the Proposed Action would, but sea turtles would be expected to avoid injurious exposure and survey vessels would pass quickly (NSF and USGS 2011). Cumulatively, the impacts on sea turtles through this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be short-term and localized, with non-biologically significant **negligible** impacts expected to result. The Proposed Action would have

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
			overlapping noise impacts by scheduling activities to avoid cumulative impacts on sea turtles. BOEM concluded that disturbance of sea turtles from underwater noise generated by site characterization and site assessment activities would likely result in temporary displacement or other behavioral or non-biologically significant physiological consequences (BOEM 2019b); impacts on sea turtles would not result in stock or population level effects.	ranges (within 200 meters). No injury to individuals would be expected as these sound sources have been shown to diminish rapidly with distance from the source (BOEM 2018). Impacts, if any, are anticipated to be temporary and **negligible**.	little to no influence on cumulative impacts through this sub-IPF.
Noise: Turbines	Sea turtles would be able to hear the continuous underwater noise of operational WTGs. As measured at the Block Island Wind Facility, this low frequency noise barely exceeds ambient levels at 164 feet (50 meters) from the WTG base (Miller and Potty 2017). Based on the results of Thomsen et al. (2015) and Kraus et al. (2016), sound pressure levels would be expected to be at or below ambient levels at relatively short distances from the WTG foundations. Furthermore, no information suggests that such noise would affect turtles (NMFS 2015).	This sub-IPF does not apply to future non-offshore wind development.	According to measurements at the Block Island Wind Facility, low frequency noise generated by turbines reaches ambient levels at 164 feet (50 meters; Miller and Potty 2017). Sound pressure level measurements from operational WTGs in Europe indicate a range of 109 to 127 dB re 1μPa at 46 and 65.6 feet (14 and 20 meters) from the WTGs (Tougaard and Henrikson 2009). Although sound pressure levels may be different in the local conditions of a project area, if sound levels at the project area are similar, operational noise could be slightly higher than ambient, which ranged from 96 to greater than 103 dB re 11μPa in the 70.8– 224 Hz frequency band at the Block Island Wind Facility study area during 50 percent of the recording time between November 2011 and March 2015 (Kraus et al. 2016). Based on the results from Thomsen et al. (2016) and Kraus et al. (2016), the received SPLs generated by the project turbines are expected to be at or below ambient levels at relatively short distances from the foundations. Given that WTG noise would be at or below ambient within a short distance from WTG bases, no measurable impacts from this sub-IPF would be expected to occur.	According to measurements at the Block Island Wind Facility, low frequency noise generated by turbines reaches ambient levels at 164 feet (50 meters; Miller and Potty 2017). Sound pressure level measurements from operational WTGs in Europe indicate a range of 109 to 127 dB re 1 μPa at 46 and 65.6 feet (14 and 20 meters) from the WTGs (Tougaard and Henrikson 2009). Although sound pressure levels may be different in the local conditions of the WDA, if sound levels at the WDA are similar, operational noise could be slightly higher than ambient, which ranged from 96 to greater than 103 dB re 11μPa in the 70.8 to 224 Hz frequency band at the study area during 50% of the recording time between November 2011 and March 2015 (Kraus et al. 2016). Based on the results from Thomsen et al. (2016) and Kraus et al. (2016), the received SPLs generated by the Project turbines are expected to be at or below ambient levels at relatively short distances from the foundations. Given that WTG noise would be at or below ambient within a short distance from WTG bases, non- measurable **negligible** impacts, if any, would be expected to occur.	The Proposed Action is expected to result in non-measurable **negligible** impacts, if any, on sea turtles through this sub-IPF due to the assumption that operational turbine noise would be similar to ambient noise levels within 164 feet (50 meters) of the WTG foundations (Miller and Potty 2017). No impacts would occur from ongoing and future non-offshore wind development. Future offshore wind (other than the Proposed Action) would be expected to result in similar impacts, but across a greater spatial scale. **Negligible** cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities, if any, would be expected due to operational turbine noise given the assumption that operational turbine noise would be expected to be similar to ambient levels within a short distance (164 feet [50 meters]) of WTG bases.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can result in high intensity, low exposure levels, and long-term, but localized intermittent risk to sea turtles. Impacts, potentially including behavioral responses, masking, TTS, and PTS, would be localized in nearshore waters. Data regarding threshold levels for impacts on sea turtles from sound exposure during pile driving are very limited, and no regulatory threshold criteria have been established for sea turtles. BOEM and NMFS have adopted the following thresholds based on current literature: • Potential mortal injury: 210 dB cumulative SPL or greater than 207 dB peak SPL (Popper et al. 2014) • Potential mortal injury: 180 dB re 1 μPa RMS (SPL; NMFS 2016) • Behavioral harassment: 166 dB to175 dB referenced to 1 μPa RMS.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Noise from pile driving would occur intermittently during installation of offshore structures for 4 to 6 hours per day over a 6- to 12-year period. Under the expanded cumulative impact scenario, up to 2,021 WTGs and 45 ESPs would be constructed incrementally over time, beginning in 2022 and continuing through 2030. Sea turtles would be displaced up to 6 hours per day during monopile installation and up to 14 hours per day during jacket installation. Thus, foraging disruptions, if any, would be temporary and are not expected to last longer than a day. This displacement would result in a relatively small energetic consequence that would not be expected to have long-term impacts on sea turtles. Although information is lacking, construction activities could temporarily displace animals into areas that have a lower foraging quality, or result in higher risk of interactions with ships or fishing gear. Potential cumulative impacts on sea turtles from multiple construction activities within the same calendar year could affect migration, feeding, breeding, and individual fitness. Intermittent, long-term impacts may be high intensity and high exposure level. The magnitude of these impacts would be dependent upon the locations of concurrent construction operations, as well as the number of hours per day, the number of days that pile driving would occur, and the time of year in which pile driving occurs. Individuals repeatedly exposed to pile driving over a season, year, or life stage may incur energetic costs that have the potential to lead to long-term consequences (Navy 2018). However, individuals may become habituated to repeated exposures over time and ignore a stimulus that was not accompanied by an overt threat (Hazel et al. 2007). Individuals have been shown to	There is a potential risk of PTS and harassment to sea turtles from pile driving due to the large radial distance to this threshold and maximum impact over the total of 102 days that pile driving may occur. BOEM anticipates unavoidable, temporary, **moderate** impacts on individual sea turtles from pile driving, given that pile-driving activities would occur over the course of a year. However, these moderate effects are expected to occur only in a very small number of turtles, and the population would likely recover after pile-driving activity has ceased. There are known occurrences of mortalities associated with pile driving, but sea turtle anatomy may make them resistant to percussive shock waves (Madin 2009). Based on the low densities of sea turtles in the Proposed Action area, the use of soft-starts to allow turtles to leave the area before injurious levels are received, and the implementation of monitoring zones and clearance zones, mortal injury would not be expected.	Pile driving noise associate with the Proposed Action may result in temporary **moderate** impacts, including behavioral and physiological effects and injury, during pile driving activities. Given that pile-driving activities would be conducted in accordance with voluntary measures such as the use of soft start procedures and PSOs, impacts on sea turtles through this sub-IPF would be expected to be reduced. Pile driving associated with ongoing, future non-offshore wind, would be expected to result in similar impacts on sea turtles. Cumulatively, the expected **moderate** impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities due to pile driving will incrementally be added to existing noise levels beginning in 2021 and continuing through 2030. Once pile driving stops, this sub-IPF would be removed from the environment and sea turtles behavior would return to normal. However, the effects of PTS may be permanent. Although permanent hearing impairment could occur, hearing ability is not believed to be critical to sea turtles completing essential life history requirements. Affected individuals would not have to adjust their life history strategies in response to PTS.

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			retain this habitation even when the repeated exposures were separated by several days (Bartol and Bartol 2011; Navy 2018).		
Noise: Cable laying/trenching	N/A	Cable laying impacts resulting from future non-offshore wind activities would be identical to those described for future offshore wind projects.	Noise associated with cable laying would be produced during route identification, trenching, backfilling, jet plow embedment, and cable protection installation by vessels and equipment, with intensity and propagation dependent upon bathymetry, local seafloor characteristics, vessels and equipment used (Taormina et al. 2018). Modeling using *in situ* data collected during cable laying operations in Europe estimate that underwater noise would remain above 120 dB re 1μPa in an area of 400 km² around the source (Bald et al. 2015; Nedwell and Howell 2004, Taormina et al. 2018). Data regarding threshold levels for impacts on sea turtles from sound exposure during construction are very limited, and no regulatory threshold criteria have been established for sea turtles (see the Noise: Pile driving sub-IPF above for more information). If cable-laying activities occur 24 hours per day, the DP vessel would be continually moving along the cable route over a 24-hour period, and the area within the 120 dB RMS isopleth would also be constantly moving over the same period. Thus, the estimated ensonified areas would not remain in the same location for more than a few hours (NMFS 2015) and it is unlikely that the sound exposure related to cable laying activities would result in impacts on sea turtles.	Noise associated with cable laying would be produced during route identification, trenching, backfilling, jet plow embedment, and cable protection installation by vessels and equipment, with intensity and propagation dependent upon bathymetry, local seafloor characteristics, vessels and equipment used (Taormina et al. 2018). Model results from DP thruster operation for the Deepwater Wind Project (NMFS 2015) indicated that the average ensonified area at the 120 dB RMS isopleth extends 2.95 miles (4.75 kilometers) from the source, with the total size of the area experiencing noise of 120 dB RMS or greater ranging from 8.9 square miles (23 km²) along the offshore export route to 9.7 square miles (25.1 km²) along the inter-array cable route. If cable-laying activities are assumed to occur 24 hours per day, the DP vessel would be continually moving along the cable route over a 24-hour period, and the area within the 120 dB RMS isopleth would also be constantly moving over the same period. Thus, the estimated ensonified areas would not remain in the same location for more than a few hours (NMFS 2015). Given that sea turtles would avoid injurious exposure to cable laying noise (see Noise: G&G above), non-measurable **negligible** impacts, if any, would be expected.	The Proposed Action is expected to result in **negligible** impacts on sea turtles through this sub-IPF, with sea turtles resuming normal behaviors once individuals are outside the ensonified area. Future non-offshore wind development would be expected to result in similar localized and temporary impacts, but across a smaller geographic scale. Cable laying impacts associated with future offshore wind development would also result in similar localized and temporary impacts, but on a larger temporal and spatial scale. Cumulatively, little spatial and/or temporal overlap from the Proposed Action and future activities would be expected. A portion of BSW's Export Cable 2 (as it approaches landfall) may be near enough to the OECC that the areas of potential effects from these cables may overlap (assuming a 10-mile [16.1-kilometer] radius around both cables) (see the BSW Project Overview map in Evans 2018). Other than the BSW project, all noise related to cable installation would be separated in space and time, and as such, **negligible** cumulative impacts of the Proposed Action when combined with past, present, and reasonably foreseeable activities, if any, relative to this sub-IPF would be expected.
Noise: Vessels	The frequency range for vessel noise (10 to 1000 Hz; MMS 2007) overlaps with sea turtles' known hearing range (less than 1000 Hz with maximum sensitivity between 200 to 700 Hz; Bartol. 1994) and would therefore be audible. However, Hazel et al. (2007) suggest that sea turtles' ability to detect approaching vessels is primarily vision-dependent, not acoustic. Sea turtles may respond to vessel approach and/or noise with a startle response (diving or swimming away) and a temporary stress response (NSF and USGS 2011). Samuel et al. (2005) indicated that vessel noise could have an effect on sea turtle behavior, especially their submergence patterns.	See Section 3.13. Any offshore projects that require the use of ocean vessels could potentially result in long-term but infrequent impacts on sea turtles, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes, especially their submergence patterns (NSF and USGS 2011; Samuel et al. 2005). However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of sea turtles and no stock or population level effects would be expected.	Future offshore wind development would require the use of ocean vessels and could potentially result in moderate intensity, long-term, infrequent impacts on sea turtles, Based on the vessel traffic generated by the proposed Project, it is assumed that construction of each individual offshore wind project (estimated to last 2 years per project) would generate an average of 25 and a maximum of 46 vessels operating in the geographic analysis area for sea turtles at any given time. This increase in vessel traffic and associated noise impacts would be at its peak in 2022 to 2023, when at least five offshore wind projects (other than the Proposed Action) would be under simultaneous construction along the East Coast—i.e., a total of approximately 125 to 230 vessels in the analysis area at any given time during peak construction.[1] Additional information regarding the expected increase in vessel traffic is provided in Section 3.13. This increased offshore wind-related vessel traffic during construction, and associated noise impacts, could result in repeated intermittent, short-term, localized, impacts on sea turtles and result in brief behavioral responses that would be expected to dissipate once the vessel or the turtle has left the area. However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy sea turtle distribution, and no stock or population level effects would be expected.	According to the Navigation Risk Assessment (COP Appendix III-I; Epsilon 2018a), current vessel traffic in the Project area and surrounding waters is relatively high, and vessel traffic within the Vineyard Wind lease area is relatively moderate (Draft EIS Section 3.4.7). The NRA for the Project area indicates that the maximum number of vessels during construction would be 46 per day (with an average of 25 per day) (COP Appendix III-I; Epsilon 2018a). This volume of traffic would vary monthly depending on weather and Proposed Action activities. During the period of maximum activity, Proposed Action construction would generate an average of 18 construction vessel trips per day in or out of construction ports. In maximum conditions, this could theoretically include up to 46 trips in a single day—including up to 4 trips per day to or from secondary ports, with the remainder originating or terminating at the New Bedford MCT, compared to the current 25 daily vessel trips measured via AIS in 2011 (COP Appendix III-I; Epsilon 2018a). Potential behavioral impacts on sea turtles from Proposed Action-related vessel traffic noise would be intermittent and temporary as animals and vessels pass near each other. During construction, impacts are anticipated to be **minor**, with sea turtle populations fully recovering following construction.	The Proposed Action is expected to result in **minor** impacts on sea turtles through this sub-IPF. Ongoing and future non-offshore wind activities would be expected to result in similar impacts on sea turtles, but would have a much larger impact given the volume of vessel traffic associated with these activities. Future offshore wind would also have similar impacts on sea turtles, but with a larger spatial extent than the Proposed Action. Cumulatively, the Proposed Action and other future offshore wind development would be expected to contribute **minor** impacts on sea turtles. However, the Proposed Action and other future offshore wind development would contribute only a small portion of the overall vessel traffic in the region (BOEM 2019b).
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Port expansion activities are localized to nearshore habitats, and are expected to result in short-term, temporary impacts, if any, on sea turtles. Vessel noise may affect sea turtles, but response would be expect to be short-term and temporary (see the Vessels: Noise sub-IPF above). The impact on water quality from sediment suspension during port expansion activities is short-term,	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will	At least two proposed offshore wind projects are contemplating port expansion/modification, in Vineyard Haven and in Montauk. Other ports would likely be upgraded along the East Coast, and some of this may be attributable to supporting the offshore wind industry. This would increase the total amount of disturbed benthic habitat, potentially resulting in impacts on some sea turtle prey species. However, this will likely be a small percentage of available	No port expansion is proposed for the Vineyard Wind 1 Project.	Given that no port expansion is proposed, the Vineyard Wind 1 Project would not be expected to contribute to this sub-IPF or cumulative impacts on sea turtles. Port expansion as a result of ongoing and non-offshore wind activities may have some temporary water quality impacts as well as long-term impacts related to increased potential for vessel collisions as a result of increased vessel traffic. Port modifications, if contemplated, would most likely occur in areas that are already industrialized, have a high level of anthropogenic

[1] As specified in SEIS Section 1.2, BOEM's analysis of the reasonably foreseeable build-out scenario assumes the potential vessel availability and supply chain challenges will be overcome and projects will advance.

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	temporary, and would be similar to those described under the New cable emplacement/maintenance IPF above.	require port modifications. Future channel deepening activities are being undertaken to accommodate deeper draft vessels for the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long-term depending on the vessel traffic increase. However, the existing suspended sediment concentrations in Nantucket Sound are already 45-71 mg/L, which is fairly high. Impacts from vessel traffic are likely to be masked by the natural variability. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future. Additional impacts associated with the increased risk of vessel strikes could also occur (see the Traffic: Vessel collisions sub-IPF below).	benthic habitat overall. Increases in port utilization due to other offshore wind projects will lead to increased vessel traffic. This increase would be at its peak during construction activities and would decrease during operations, but would increase again during decommissioning. In addition, any related port expansion and construction activities related to the additional offshore wind projects would add to increased turbidity in the coastal waters. Impacts associated with increased turbidity are not expected to be biologically significant (NOAA 2020).		activity, and have been previously altered. Port expansion associated with future offshore wind development may result in similar impacts, but the incremental increase from offshore wind development would be a minor contributor to port expansion required to meet commercial, industrial, and recreational demand. The current bearing capacity of existing ports was considered suitable for wind turbines, requiring no port modifications for supporting offshore wind development (DOE 2014). Cumulatively, the impacts on sea turtles through this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities are expected to be short-term and localized, with non-biologically significant **negligible** impacts expected to result. The Proposed Action would have no influence on cumulative impacts through this sub-IPF.
Presence of structures: Entanglement or ingestion of lost fishing gear	The Mid-Atlantic region has more than 130 artificial reefs. This sub-IPF may result in long-term, high intensity impacts, but with low exposure due to localized and geographic spacing of artificial reefs. Currently bridge foundations and the Block Island Wind Facility may be considered artificial reefs and may have higher levels of recreational fishing, which increases the chances of sea turtles encountering lost fishing gear, resulting in possible ingestions, entanglement, injury, or death of individuals (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014) if present nearshore where these structures are located. There are very few, if any, areas on the OCS geographic analysis area for sea turtles that would serve to concentrate recreational fishing and increase the likelihood that sea turtles would encounter lost fishing gear.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Development of the projects in the expanded cumulative scenario would install more buoys, met towers, foundations, and hard protection. Approximately 1,723 acres (7 km^2) of hard protection atop cables, 1,221 acres (5 km^2) of foundation scour protection, and the vertical surfaces of up to 2,066 new foundations would increase the risk of gear loss/damage by entanglement and the ensuing impacts on sea turtles over an assumed 6- to 10-year period. The presence of structures and the anticipated reef effect has the potential to lead to increased recreational fishing within the WDAs, which would result in moderate exposure, high intensity risk of interactions with fishing gear such as hooking, abrasions, loss of limbs, and increased drag. These interactions could result in injury, mortality, reduced foraging efficiency, and ability to avoid predators (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014).	The Proposed Action is expected to add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations and scour/cable protection would remain for the life of the Project (30 years). Interactions with lost fishing gear around WTG foundations is a potential long-term risk and may be high intensity, resulting in entanglement, ingestion, injury, and death (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014). Exposure level would be considered low due to up to 102 foundations in the WDA, but would pose a long-term risk. As part of the Vineyard Wind 1 Project design, annual monitoring, reporting, and cleanup of fishing gear around the base of the WTGs would be conducted. This would remove any identified fishing gear and reduce the potential for impacts on sea turtles to **negligible** levels.	The risk of impacts from this sub-IPF is proportional to the amount of structure present. The Proposed Action would add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. With the annual removal of fishing gear, impacts due to the Proposed Action would be **negligible**. Ongoing entanglement and gear loss/damage at existing structures would periodically result in similar localized, short-term impacts on sea turtles. Future offshore wind activities, other than the proposed Project, would add approximately 2,944 acres (12 km^2) of scour/cable protection and the vertical surfaces of up to 2,066 new foundations. Cumulatively, up to 2,066 foundations and 2,944 acres (12 km^2) of scour/cable protection associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would increase the risk of highly localized, periodic, short-term impacts that may be **moderate**. Both the Vineyard Wind 1 Project and other future offshore wind development would be expected to contribute to cumulative impacts on sea turtles. The contribution of the maximum of 100 WTGs and 151 acres of scour protection is relatively small when compared to the 2,066 WTGs and 2,944 acres (12 km^2) acres of scour/cable protection that are part of the full cumulative impact scenario in the region.
Presence of structures: Habitat conversion and prey aggregation	The Mid-Atlantic region has more than 130 artificial reefs. Hard-bottom (scour control and rock mattresses) and vertical structures (bridge foundations and Block Inland Wind Facility WTGs) in a soft-bottom habitat can create artificial reefs, thus inducing the reef effect (Taormina et al. 2018; NMFS 2015). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for sea turtles compared to the surrounding soft-bottoms.	The presence of structures associated with non-offshore wind development in near-shore coastal waters has the potential to provide habitat for sea turtles as well as preferred prey species. This reef effect has the potential to result in long-term, low-intensity beneficial impacts. Bridge foundations will continue to provide foraging opportunities for sea turtles with measurable benefits to some individuals.	Development of the projects in the expanded cumulative scenario would install more buoys, met towers, foundations, and hard protection. Approximately 2,944 acres (12 km^2) of hard protection and the vertical surfaces of up to 2,066 new foundations can create artificial reefs, thus inducing the reef effect (Taormina et al. 2018; Causon and Gill 2018). In the Gulf of Mexico, loggerhead, leatherback, green, Kemp's ridley, and hawksbill (*Eretmochelys imbricate*) sea turtles have been documented in the vicinity of offshore oil and gas platforms, with the probability of occupation increasing with the age of the structures (Gitschlag and Renauld 1989; Gitschlag and Herczeg 1994; Hastings et al. 1976, Rosman et al. 1987). Sea turtles would be expected to use the habitat between and around structures for feeding, breeding, resting, and migration.	The Proposed Action is expected to add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations would remain for the life of the Project, and scour/cable protection would likely remain permanently. Foundations may provide foraging and sheltering opportunities for sea turtles. The Proposed Action could also result in increased primary production and zooplankton abundance, which could serve as food for some sea turtle species as well as some sea turtle prey species. There may be measurable long-term, **minor beneficial** impacts from the presence of foundations.	The Proposed Action would add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations may serve as foraging opportunities for sea turtles, with anticipated long-term, **minor beneficial** impacts from the presence of foundations. Ongoing and future non-offshore wind activities would be expected to result in similar impacts, but on a smaller geographic scale, and would be limited to near-shore habitat. Future offshore wind development would also be expected to result in similar impacts, but on a larger spatial scale, given the addition of 2,066 structures and 2,944 acres (12 km^2) of hard protection. Cumulatively, these impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be expected to result in long-term, **moderate beneficial** impacts on sea turtles due to the large number of structures. However, these beneficial impacts may be masked by adverse impacts resulting from increased interactions with recreational fishing gear (see the Presence of structures: Entanglement or ingestion of lost fishing gear sub-IPF above). The contribution of the maximum of 100 WTGs and 151 acres of scour protection is relatively small when compared to the 2,066 WTGs and 2,944 acres (12 km^2) acres of scour/cable

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
					protection that are part of the full cumulative impact scenario in the region.
Presence of structures: Avoidance/ displacement	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF. There may be some impacts resulting from the existing Block Island Wind Facility, but given that there are only 5 WTGs, no measurable impacts are occurring.	Not contemplated for non-offshore wind facility sources.	Development of the projects in the expanded cumulative scenario would install more buoys, met towers, foundations, and hard protection. Under the full build-out scenario, an estimated 2,066 structures will be added on the OCS over a 6- to 10-year period beginning in 2022, and they would remain until decommissioning of each facility is complete (30 years). Although 2,066 structures are anticipated, spacing will be sufficient to allow unobstructed access within wind facilities and between wind facility projects. Avoidance of WDAs due to the presence of new structures is possible. However, in the Gulf of Mexico, loggerhead, leatherback, green, Kemp's ridley, and hawksbill sea turtles have been documented in the vicinity of offshore oil and gas platforms, with the probability of occupation increasing with the age of the structures (Gitschlag and Renauld 1989; Gitschlag and Herczeg 1994; Hastings et al. 1976, Rosman et al. 1987). As such, sea turtles would be expected to use habitat in between the WTGs as well as around structures for feeding, breeding, resting, and migrating for short periods, but residency times around structures may increase with the age of structures if communities develop on and around foundations.	The Proposed Action is expected to add up to 102 foundations on the OCS. The proposed spacing between structures is expected to be sufficient to allow unimpeded access within the WDA. Based on the best available information, non-measurable **negligible** impacts, if any, are anticipated. However, temporary displacement from the WDA during Project construction may occur. This could displace individuals into areas with higher risk of interactions with fishing and commercial vessels (see the Traffic: Vessel collisions sub-IPF below).	The Proposed Action is expected to result in non-measurable **negligible** impacts on sea turtles through this sub-IPF. Additional impacts could occur if individuals are displaced into areas with increased risk of vessel interactions (see the Traffic: Vessel collisions sub-IPF below) if displacement occurs during construction. Ongoing and future non-offshore wind activities would not be expected to result in any impact on sea turtles. Future offshore wind activities would be expected to result in similar impacts, but over a greater spatial and temporal scale. However, the proposed spacing between structures would be sufficient to allow unimpeded access between offshore wind facilities and between individual WTGs. Cumulatively, impacts related to avoidance/ displacement associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities as a result of 2,066 new, novel structures on the OCS would be expected to be **negligible**. However, additional impacts may occur if individuals are displaced into areas with a higher risk of vessel and/or fisheries interactions (see the Traffic: Vessel collisions sub-IPF below).
Presence of structures: Behavioral disruption - breeding and migration	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.	Although 2,066 structures are anticipated, spacing would be sufficient to allow unimpeded access among WTGs within wind facilities and between wind facility projects. Sea turtles would be expected to use habitat in between the WTGs as well as around structures for feeding, breeding, resting, and migrating for short periods, but residency times around structures may increase with the age of structures if communities develop on and around foundations. Although migrating sea turtles could make temporary stops to rest and feed during migrations, the presence of structures are not expected to result in noticeable changes to overall migratory patterns in sea turtles.	It is not likely that sea turtles would avoid the WDA due to sea turtle size relative to turbine spacing, and to documented use of structures in the offshore environment (Gitschlag and Renauld 1989; Gitschlag and Herczeg 1994; Hastings et al. 1976, Rosman et al. 1987). Sea turtles would be expected to use habitat in between the WTGs as well as around structures for feeding, breeding, resting, and migrating for short periods, but residency times around structures may increase with the age of structures if communities develop on and around foundations. Although migrating sea turtles could make temporary stops to rest and feed duration migrations, the presence of structures are not expected to result in noticeable changes to overall migratory patterns in sea turtles. As such, non-measurable, **negligible** impacts, if any, would be expected.	Although an estimated 2,066 new foundations are anticipated, spacing would be sufficient to allow unimpeded access within the Proposed Action, and **negligible** impacts, if any, would be expected. No ongoing or non-offshore wind activities would contribute to this sub-IPF. Future offshore wind development would be expected to result in similar impacts, but over a greater geographic extent. Cumulatively, impacts related to disruptions of breeding and migration associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities as a result of 2,066 new, novel structures on the OCS would be expected to be **negligible**.
Presence of structures: Displacement into higher risk areas (Vessels and Fishing)	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.	Although construction activities would likely temporarily displace animals into areas that have a higher risk of interactions with ships or fishing gear, the operations phase may or may not result in any displacement. The 1-nautical-mile grid spacing and low operational noise levels allow unobstructed access to habitat in wind facility areas. Some level of sea turtle displacement from the lease areas into areas with a higher potential for interactions with ships or fishing gear during the construction phases of future offshore wind development may occur (Section 3.13). Given the use of structures in the Gulf of Mexico, as described above, no long-term displacement would be expected. Changes in the area of fishing effort are not anticipated with the proposed WTG spacing, but could potentially occur if fisheries choose to operate outside future offshore wind projects. If the area of effort were to change to areas adjacent to offshore wind projects, increased risk could be expected than currently exists within wind facility areas. If gear changes were to result from the presence of offshore WTG foundations, additional impacts on sea turtles could occur. However, no new gear types or configurations that could be used have	If sea turtles avoid the WDA, they may be at increased risk of interactions with potentially high vessel traffic including fisheries vessels and fisheries gear. The risk of displacement from the WDA would exist throughout the operations phase of the Project.	Although construction activities for Vineyard Wind 1 Project and other offshore wind projects would likely temporarily displace animals into areas that have a higher risk of interactions with ships or fishing gear, and have the potential to result in **minor** impacts on sea turtles, the operations phase may or may not result in any displacement. Ongoing and future non-offshore wind activities would be expected to result in similar impacts, but on a smaller geographic scale. Future offshore wind activities would also be expected to result in similar impacts, but on a greater temporal and spatial scale. However, the 1-nautical-mile grid spacing and low operational noise levels allows unobstructed access to habitat in wind facility areas. Changes in the area of fishing effort is not anticipated with the proposed WTG spacing, but could potentially occur if fisheries choose to operate outside future offshore wind projects. If the area of effort were to change to areas adjacent to offshore wind projects, increased risk could be expected than currently exists within wind facility areas. If gear changes were to result from the presence of offshore WTG foundations, additional impacts on sea turtles could occur. However, no new gear types or configurations that could be used have been identified that could result from the presence of these structures and cumulative impacts are expected to be **minor**.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
			been identified that could result from the presence of these structures.		
Traffic: Vessel collisions	Current activities contributing to this sub-IPF include port traffic levels, fairways, traffic separation schemes, commercial vessel traffic, recreational and fishing activity, and scientific and academic vessel traffic. Propeller and collision injuries from boats and ships are common in sea turtles. Vessel strike is an increasing concern for sea turtles, especially in the southeastern United States, where development along the coasts is likely to result in increased recreational boat traffic. In the United States, the percentage of strandings of loggerhead sea turtles that were attributed to vessel strikes increased from approximately 10% in the 1980s to a record high of 20.5% in 2004 (NMFS and USFWS 2007). Sea turtles are most susceptible to vessel collisions in coastal waters, where they forage from May through November. Vessel speed may exceed 10 knots in such waters, and those vessels travelling at greater than 10 knots would pose the greatest threat to sea turtles.	Vessel traffic associated with non-offshore wind development has the potential to result in an increased collision risk. While these impacts would be high consequence, the patchy distribution of sea turtles makes stock or population-level effects unlikely (Navy 2018).	Based on the vessel traffic generated by the proposed Project, it is assumed that construction of each individual offshore wind project (estimated to last 2 years per project) would generate an average of 25 and a maximum of 46 vessels operating in the geographic analysis area for sea turtles at any given time. This increase in vessel traffic and associated collision risk would be at its peak in 2022 to 2023, when at least five offshore wind projects (other than the Proposed Action) would be under simultaneous construction along the East Coast—i.e., a total of approximately 125 to 230 vessels in the geographic analysis area at any given time during peak construction.[2] Additional information regarding the expected increase in vessel traffic is provided in Section 3.13. Offshore wind will result in a small incremental increase in vessel traffic volume relative to ongoing and future non-offshore wind activities (BOEM 2019b). This increased collision risk has the potential to result in injury or mortality to individuals, but would not be expected to have stock or population-level impacts on sea turtles given their patchy distribution within the geographic analysis area. Further, implementation of the following BMP (Appendix A Table A-5) would be reduce the potential for impacts relative to this sub-IPF during offshore wind development: Vessels related to project planning, construction, and operation shall travel at reduced speeds when assemblages of cetaceans are observed and maintain a reasonable distance from whales, small cetaceans, and sea turtles as determined during site-specific consultations.	The increase in vessel traffic associated with the Vineyard Wind 1 Project would be greatest during construction, with an estimated maximum of 46 vessels operating in the WDA daily. Given the mobility of sea turtles, the use of PSOs and voluntary mitigation measures such as vessel speed restrictions and the implementation of monitoring zones and clearance zones, interactions with Vineyard Wind vessels and sea turtles would not be expected to occur. Although vessel strike is a major source of human-caused sea turtle mortality, the above measures reduce the probability of a Project-related strike. The Project would have a period of peak vessel activity lasting approximately 2 years (during construction. The increase in vessel round trips during construction and installation is likely to increase the relative risk of vessel strike for sea turtles. However, the vessel strike avoidance measures that Pyć et al. (2018) outline are designed to avoid vessel strikes on sea turtles by reducing vessel speed and maintaining a distance of 49.2 feet (15 meters) or greater from sighted turtles. The additional measure of training personnel to watch for and report sea turtles would further increase vigilance to avoid striking sea turtles. Due to the implementation of these measures, BOEM anticipates that the chance of vessel strikes on sea turtles is highly unlikely; therefore, potential temporary effects of vessel traffic due to construction and installation vessels are anticipated to be **minor.**	While some increase in vessel traffic associated with the Vineyard Wind 1 Project would occur, the incremental increase would be very small relative to current vessel traffic in the area. Because measures such as the use of PSO, PAM, and vessel speed restrictions would be implemented, impacts on sea turtles through this sub-IPF would be expected to be **minor**. Ongoing and future non-offshore wind activities have the potential to result in sea turtle mortality throughout the geographic analysis area for sea turtles, but impacts would be concentrated in shipping lanes and other areas regularly traversed by vessels (Appendix B Table 3.13-1). Future offshore wind activities may also pose a significant risk to sea turtles through this sub-IPF, particularly if BOEM and NMFS measures are not included. The relative risk of vessel strikes from wind industry vessels is dependent upon the stage of development, time of year, number of vessels, and speed of vessels during each stage. Cumulatively, impacts related to vessel collisions on the OCS associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be expected to be **moderate,** given the level of vessel traffic involved during peak construction. The contribution of the Proposed Action is relatively small when compared to the number of vessel trips associated with future offshore wind development. However, both the Proposed Action and future offshore wind development would contribute only a small portion of the overall vessel traffic in the region (BOEM 2019b).
Climate change: Warming and sea level rise, storm severity/frequency	Increased storm frequency could lead to long-term, high-consequence impacts on sea turtle onshore beach nesting habitat, including changes to nesting periods, changes in sex ratios of nestlings, drowned nests, as well as loss or degradation of nesting beaches. Offshore impacts, including sedimentation of near-shore hard bottom habitats have the potential to result in long-term, high consequence changes to foraging habitat availability for green turtles.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to increased energetic costs and reduced fitness of individual sea turtles. Because this sub-IPF is a global phenomenon, impacts on sea turtles though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change.
Climate change: Ocean acidification	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine ecosystems by contributing to reduced growth or the decline of invertebrates that have calcareous shells.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to reduced growth or the decline of some sea turtle prey species. Because this sub-IPF is a global phenomenon, impacts on sea turtles though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change.
Climate change: Warming and sea level rise, altered habitat/ecology	This sub-IPF has the potential to lead to long-term, high-consequence impacts on sea turtles by influencing distributions of sea turtles and/or prey resources. This sub-IPF has the potential to lead to long-term, high-consequence impacts on sea turtle breeding, foraging, and sheltering habitat use.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to changes in the distribution and availability of breeding, sheltering, and/or foraging habitat as well as migration disruptions. Because this sub-IPF is a global phenomenon, impacts on sea turtles though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change.
Climate change: Warming and sea level rise, altered migration patterns	This sub-IPF has the potential to lead to long-term, high-consequence impacts on sea turtle habitat use and migratory patterns.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to changes in habitat use and seasonal migration timing and patterns. Because this sub-IPF is a global phenomenon, impacts on sea turtles though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change.

[2] As specified in SEIS Section 1.2, BOEM's analysis of the reasonably foreseeable build-out scenario assumes the potential vessel availability and supply chain challenges will be overcome and projects will advance.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusions
Climate change: Warming and sea level rise, disease frequency	Climate change, influenced in part by greenhouse gas emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the frequencies of various diseases of sea turtles such as fibropapillomatosis.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to the incidence, prevalence, and severity of diseases in sea turtle populations. Because this sub-IPF is a global phenomenon, impacts on sea turtles though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change.
Climate change: Warming and sea level rise, protective measures (barriers, sea walls)	The proliferation of coastline protections have the potential to result in long-term, high-consequence impacts on sea turtle nesting by eliminating or precluding access to potentially suitable nesting habitat or access to potentially suitable habitat.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to impacts on sea turtles, and has the potential to degrade, eliminate, or preclude access to currently suitable nesting habitat. Because this sub-IPF is a global phenomenon, impacts on sea turtles though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change.
Climate change: Warming and sea level rise, storm severity, frequency, sediment erosion, deposition	Sediment erosion and/or deposition in coastal waters have the potential to result in long-term, high-consequence impacts on green sea turtle foraging habitat. Additionally, sediment erosion has the potential to result in the degradation or loss of potentially suitable nesting habitat.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This sub-IPF may contribute to impacts on green turtle foraging habitat, and has the potential to degrade or eliminate currently suitable nesting habitat. Because this sub-IPF is a global phenomenon, impacts on sea turtles though this sub-IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change.

μPa = micropascal; μT = microtesla; AC = alternating current; ADLS = Aircraft Detection Light System; AIS = Automatic Identification System; BMP = best management practice; BOEM = Bureau of Ocean Energy Management; BSW = Bay State Wind; CFR = Code of Federal Regulations; COP = Construction and Operations Plan; dB = decibel; dB re 1 μPa = decibels relative to one micropascal; dB RMS = decibel root mean square; DC = direct current; DP = dynamic positioning; DPS = distinct population segment; EMF = electromagnetic field; ESP = electrical service platform; FAA = Federal Aviation Administration; FCC = Federal Communications Commission; G&G = Geological and Geophysical; HRG = high resolution geophysical; Hz = hertz; IHA = Incidental Harassment Authorization; IPF = impact-producing factors; km^2 = square kilometers; m^2 = square meters; MCT = Marine Commerce Terminal; met = meteorological; mg/L = milligrams per liter; NARW = North Atlantic right whale; NEPA = National Environmental Policy Act; NMFS = National Marine Fisheries Service; NRA = Navigational Risk Assessment; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor; PAM = passive acoustic monitoring; PSO = protected species observer; PTS = permanent threshold shift; RMS = root mean square; SEIS = Supplemental EIS; SOV = service operations vessel; SPL = sound pressure level; TTS = temporary threshold shift; USACE = U.S. Army Corps of Engineers; USCG = US Coast Guard; WDA = Wind Development Area; WTG = wind turbine generator

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Table 3.6-2: Sea Turtle Incidental Hooking and/or Entanglement with Recreational Fishing Gear from 2016 to 2018

State	Loggerhead Sea Turtle (*Caretta caretta*)	Green Sea Turtle (*Chelonia mydas*)	Leatherback Sea Turtle (*Dermochelys coriacea*)	Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)	Unknown	State Total
Delaware	-	-	-	1		**1**
Massachusetts	-	-	1	-		**1**
New Jersey	1	-	-	1		**2**
New York	3	-	-	-		**3**
Virginia	32	2	-	120	25	**179**
Total	**36**	**2**	**1**	**122**	**25**	**186**

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Table 3.7-1: Summary of Activities and the Associated Impact-Producing Factors for Demographics, Employment, and Economics

The geographic analysis area for demographics, employment, and economics includes the counties where proposed onshore infrastructure and port cities supporting offshore wind energy projects are located, as well as counties in closest proximity to the WDA (Barnstable, Bristol, Dukes, and Nantucket counties, Massachusetts; and Providence and Washington counties, Rhode Island). These counties are the most likely to experience beneficial or adverse economic impacts from the Proposed Action.

Barnstable, Dukes, and Nantucket counties are highly dependent on tourism and visitors, and have a high proportion of seasonally occupied homes (another indication of recreational and tourist use). The economies of Martha's Vineyard and Nantucket are also less diverse than the mainland jurisdictions. BOEM anticipates Dukes, Barnstable, and Nantucket counties to continue to be heavily dependent on tourism and recreation, which accounts for 96, 87, and 99 percent of the overall Ocean Economy GDP of those respective counties (NOAA 2018c).

While median income, housing values, and employment rates vary, the mainland study area generally displays strong and diverse economic activity. In Bristol, Providence, and Washington counties, ocean economy sectors would continue to be more diverse, with a higher proportion of shipping and commercial fishing, while also constituting a smaller proportion of the local economy. Bristol County contains the Port of New Bedford, the highest-grossing commercial fishing port in the United States. Washington County contains Port Judith, a center of the Rhode Island and regional fishing industry.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Energy generation/ security	In 2017, Massachusetts energy production totaled 125.2 trillion Btu, of which 72.4 trillion Btu was from renewable sources, including geothermal, hydroelectric, wind, solar, and biomass (U.S. Energy Information Administration 2018).	Ongoing development of onshore solar and wind energy would provide diversified, small-scale energy generation. State and regional energy markets would require additional peaker plants and energy storage to meet the electricity needs when utility scale renewables are not producing.	Once built, offshore wind energy projects could produce energy at long-term fixed costs, which could provide a hedge against fossil fuel price volatility. A greater share of electricity produced by offshore wind for a given market would result in a greater need for energy storage and peaker generation (U.S. Energy Information Administration 2018). Approximately 9.4 GW of capacity is estimated to occur in the Rhode Island/Massachusetts offshore areas.	Operation of the Vineyard Wind 1 Project would produce up to 800 MW of electricity, or 3.6% of the estimated 22 GW of reasonably foreseeable offshore wind generation potential for the U.S. East Coast. Between 8 and 9 GW of this capacity is estimated to occur in the Rhode Island and Massachusetts offshore areas. This would have regional, long-term, **minor beneficial** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this IPF under the Proposed Action would include a long-term, direct and indirect contribution to energy security and resiliency, providing economic benefit through a stable supply of energy and predictable energy prices. This would have **minor**, long-term, regional, **beneficial** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would continue existing energy generation and energy security concerns. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Cumulatively, the impacts on demographics, employment, and economics from this IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be regional (if not national), long-term, **minor beneficial** impacts on demographics, employment, and economics, due to the substantial increase in renewable energy generation.
Light: Structures	Offshore buoys and towers emit low-intensity light, while onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.	In accordance with the cumulative assumptions in Appendix A, as well as USCG and Federal Aviation Administration requirements, aviation hazard lighting from up to 709 WTGs (out of 775 assumed as part of the No Action Alternative) could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions. Nighttime views of lights on offshore wind energy structures could affect decisions of visitors in selecting coastal locations to visit or potential residents selecting residences. These lights would be incrementally added over the 6- to 10-year construction period, and would be visible for the assumed 30-year operating life of the No Action Alternative projects. Visibility would depend on distance from shore, topography, and atmospheric conditions. ADLS, if implemented, would reduce the amount of time that WTG lighting is visible, thus reducing indirect impacts on demographics, employment, and economics associated with lighting.	Aviation hazard lighting from all the Proposed Action's WTGs could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions, for the duration of the Proposed Action's 30-year operational life. When illuminated, lighting on WTGs would be visible from higher elevations and some locations along the coastline of Martha's Vineyard and Nantucket, possibly affecting visitor decisions on which locations to visit. Vineyard Wind has committed to implement ADLS (as described in Draft EIS Section 3.4.1.3) as a voluntarily measure, which would activate the Proposed Action's WTG lighting when aircraft approach the Vineyard Wind 1 Project WTGs, which is expected to occur less than 0.1% of annual nighttime hours. This would have localized, long-term, **negligible** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would be indirect, resulting from impacts on businesses serving the recreation and tourism industry caused by the visibility of aviation hazard lighting for the Proposed Action's WTGs from some beaches and coastal locations on Martha's Vineyard and Nantucket. The presence of these lights could potentially influence decisions made by visitors in selecting activities, facilities, and lodging, as well as potential residents selecting home locations. This would have localized, long-term, **negligible** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would add widespread lighting on onshore structures, along with minimal offshore lighting. Impacts from future offshore wind activities would be similar to those of the Proposed Action, due to aviation hazard lighting from 709 total WTGs (including the Proposed Action) visible from the same locations as the Proposed Action, as well as additional coastal locations in Massachusetts and Rhode Island. Cumulatively, the impacts on demographics, employment, and economics from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be localized, long-term, constant, and **negligible** to **minor**, specifically in locations where lighting from more than one project is visible, along with onshore lighting. Onshore lighting from ongoing activities would be closer to onshore viewers (who would thus perceive onshore lighting as more intense), and onshore lighting would generally contribute the largest part of the cumulative impact of lighting on structures, except in cases where minimal onshore lighting is present. ADLS, if implemented on offshore wind projects other than the Proposed Action, would reduce cumulative impacts to **negligible.**
Light: Vessels	Ocean vessels have an array of lights including navigational lights and deck lights.	See Section 3.13.1 and Table 3.13-1. Anticipated modest growth in vessel traffic would result in some growth in the nighttime traffic of vessels with lighting.	Lighting for construction or maintenance vessels would be needed during early morning, dusk, or nighttime transit or work activities. Concurrent construction of up to 4 offshore wind projects could occur, all potentially contributing to nighttime vessel traffic. Vessel lights would be visible from coastal businesses, especially near the ports used to support offshore wind construction.	Nighttime lighting for vessels in transit and in the offshore work area would occur when Project construction or maintenance takes place at night. Short-term vessel lighting is not anticipated to discourage tourist-related business activities and would not affect other businesses; therefore, lighting would have localized, intermittent, short-term, **negligible** impacts.	Nighttime vessel lighting from Vineyard Wind 1 construction or maintenance would have short-term, **negligible** impacts on demographics, employment, and economics. Nighttime vessel lighting from ongoing activities and future non-offshore wind vessel traffic would likely grow modestly. Future offshore wind activities could result in short-term increases in nighttime vessel transits and offshore work depending on the extent of nighttime construction work. The increased volume of vessel lights may be visible from coastal accommodations and tourist-serving businesses, but is not anticipated to discourage tourist business; therefore, this sub-IPF would have localized, intermittent, short-term, **negligible** impacts on demographics, employment and economics.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors. In the geographic analysis area for demographics, employment, and economics there are six existing power cables. See Appendix A, Table A-5 for details.	The FCC has two pending submarine telecommunication cable applications in the North Atlantic. Future new cables, perhaps including those connecting Martha's Vineyard and/or Nantucket to the mainland, would disturb the seafloor and cause temporary increases in suspended sediment resulting in infrequent, localized, short-term impacts over the next 30 years.	Cable installation for each project could temporarily impact commercial/for-hire fishing businesses by reducing income and increasing costs during installation due to the need to relocate away from work areas, the disruption of fish stocks, and the prevention of fixed gear deployment in work areas. About 3,398 acres (13.8 km^2) of seafloor disturbance would occur, resulting in fishing vessels not likely having access to affected areas during active construction. Concrete mattresses covering cables in hard-bottom areas could hinder commercial trawlers/dredgers over the long term. See Section 3.11.	Cable installation could temporarily impact commercial/for-hire fishing businesses by reducing income and increasing costs during installation due to the need to relocate away from the 61- to 69-mile (depending on the landfall location selected) Vineyard Wind 1 Project OECC work area and approximately 233 acres (0.9 km^2) of seafloor disturbance, the disruption of fish stocks, and the prevention of fixed gear deployment in the work area. Concrete mattresses covering cables in hard-bottom areas (estimated to be less than 10% of OECC and inter-array cable route length—Draft EIS Section 2.1.1) could hinder commercial trawlers/dredgers over the long term. Installation would have localized, short-term, and **minor** impacts on demographics, employment, and	The impacts on demographics, employment, and economics from this IPF under the Proposed Action would include temporary, localized hindrances to commercial/for-hire fishing businesses during cable emplacement; periodic disturbance of commercial fishing when maintenance is needed; and long-term prevention of commercial trawlers/dredgers where concrete mattresses are used to cover cable. Installation would have localized, short-term, **minor** impacts on demographics, employment, and economics, while maintenance would have isolated, long-term, **negligible** impacts. Ongoing activities and future non-offshore wind activities would contribute similar types of impacts, especially along the routes of potential cables, perhaps connecting Martha's Vineyard and/or Nantucket to the mainland. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Cumulatively, the impacts on demographics, employment, and economics from this IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be temporary and localized, except for long-term impacts on commercial trawlers and dredgers in areas where concrete mattresses are used, would be **minor.**

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
				economics, while maintenance would have isolated, long-term, **negligible** impacts.	
Noise: O&M	Limited to South Fork Wind Project	Not applicable	Indirect economic impacts on commercial fishing businesses and recreational businesses could result from direct impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities (SEIS Sections 3.3 through 3.6); and noise from maintenance and repair operations that make the wind energy facilities less attractive to fishing operators and recreational boaters.	Indirect economic impacts on commercial fishing businesses and recreational businesses could result from direct impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities within the proposed Project area (SEIS Sections 3.3 through 3.6); and noise from maintenance and repair operations that make the wind energy facilities less attractive to fishing operators and recreational boaters. This would have, localized, intermittent, long-term, **negligible** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include temporary, periodic noise from maintenance that may indirectly affect businesses due to the impact on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing. This would have localized, intermittent, long-term, **negligible** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities (limited to the Block Island Wind Project) would have similar contributions as the Proposed Action. Cumulative impacts on demographics, employment, and economics from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would only occur where operational maintenance and repair noise from the Proposed Action and the South Fork Wind Project was simultaneously audible, and would therefore be localized, intermittent, long-term, and **negligible**.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the geographic analysis area for demographics, employment, and economics other than ongoing activities.	Noise from pile driving from offshore wind activities could result in indirect, temporary impacts on employment and economics due to the impact on commercial fishing and marine recreational businesses. Pile driving noise would affect commercial and for-hire fishing businesses due to the impacts on fish populations. The South Fork Wind Project is the only other project potentially under construction at the same time as the Vineyard Wind 1 Project that could generate cumulative pile driving noise impacts for up to 2 weeks.	See Sections 3.4.1 and 3.11. Noise from pile driving for the Proposed Action could result in indirect, temporary impacts on employment and economics due to the impact on commercial fishing and marine recreational businesses. Pile driving noise would affect commercial and for-hire fishing businesses, due to the impacts on fish populations. This would have localized, short-term, intermittent, **negligible**, impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include temporary noise that may indirectly affect businesses due to direct impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing. This would have localized, intermittent, short-term, **negligible** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would contribute similar types of impacts in nearshore areas. Future offshore wind activities would not contribute to this sub-IPF. Cumulative impacts on demographics, employment, and economics from this sub-IPF would not occur because pile-driving noise from the Proposed Action and ongoing activities would not be simultaneously audible due to the distance between the Proposed Action and potential nearshore pile-driving locations.
Noise: Cable laying/trenching	Infrequent trenching for pipeline and cable laying activities emit noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	Periodic trenching would be needed over the next 30 years for repair or new installation of underground infrastructure.	Offshore and onshore trenching would occur during construction (installation of offshore and onshore cables), and rarely during operations (maintenance and repair). Noise from onshore cable installation could temporarily disrupt business operations. The South Fork Wind Project is the only other project potentially under construction at the same time as the Vineyard Wind 1 Project that could generate cumulative offshore trenching noise impacts.	See Sections 3.4 and 3.11. Noise from trenching for the Proposed Action could result in indirect, temporary impacts on employment and economics due to the impact on commercial fishing, marine recreational businesses, and onshore recreational businesses. Trenching noise would affect commercial and for-hire fishing businesses due to the impacts on fish populations, and would affect onshore recreational businesses due to noise near public beaches, parks, residences, and offices. This would have localized, intermittent, short-term, **negligible** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include: • Temporary offshore noise that may indirectly affect businesses due to direct impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing • Temporary onshore noise that would inconvenience beach visitors, residents, and office workers This would have localized, intermittent, short-term, **negligible** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would infrequently contribute similar types of impacts as the Proposed Action. Future offshore wind activities (limited to the South Fork Wind Project) and onshore wind activities would have similar contributions as the Proposed Action. Cumulative offshore impacts on demographics, employment, and economics from this sub-IPF would not occur, because trenching noise from the Proposed Action and the South Fork Wind Project would not be simultaneously audible due to the distance between the projects and construction timing. Cumulative onshore impacts would only occur if multiple onshore trenching activities are simultaneously audible, and are thus expected to be rare. In such cases, cumulative impacts would be localized, intermittent, short-term, and **negligible**.
Noise: Vessels	See Section 3.13. Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels.	Planned new barge route and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.	Vessel traffic noise would be generated for installation, maintenance, and repair. Indirect economic impacts on commercial fishing businesses and marine recreational businesses could result from vessel noise impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities. Vessel traffic would occur over the life of each wind energy facility and would be variable in all phases.	See Sections 3.4 and 3.11. Vessel noise from the Proposed Action could result in indirect, temporary impacts on employment and economics due to the impact on commercial fishing, marine recreational businesses, and onshore recreational businesses. Vessel noise would affect commercial and for-hire fishing businesses, due to the impacts on fish populations, and would affect onshore recreational businesses due to noise near the Port of New Bedford staging area, other ports used for staging during construction, and the Vineyard Haven harbor for operations. This would have intermittent, short-term, **negligible** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include temporary offshore noise that may indirectly affect businesses due to direct impacts on commercial fishing, recreational fishing, and marine sightseeing. This would have short-term, intermittent, **negligible** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would contribute similar types of impacts as the Proposed Action, especially near ports and docks. Future offshore wind activities (limited to the South Fork Wind Project) would have similar contributions as the Proposed Action. Cumulative impacts on demographics, employment, and economics from this sub-IPF would most frequently occur near ports used to support offshore wind energy project construction, and occasionally farther offshore where vessels associated with multiple projects are simultaneously audible. Cumulative impacts associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be continuous, long-term, and **negligible**.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The Marine Commerce Terminal at the Port of New Bedford was upgraded by the port specifically to support the construction of offshore wind energy facilities.	Ports would need to perform maintenance and upgrade facilities over the next 30 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.	Offshore wind installation would require port facilities for berthing, staging, and loadout. Development activities would support port investment and employment, and would also support jobs and businesses in supporting industries and commerce. A recent report by the American Wind Energy Association (AWEA 2020) lists over $1.3 billion in announced investments in wind energy manufacturing facilities, ports, and vessel construction in Atlantic states. Offshore wind energy development could support $14.2 to 25.4 billion in output, $7 to 12.5 billion in value added, and 45,500 to 82,500 jobs by 2030	Vineyard Wind 1 Project has committed to using the Marine Commerce Terminal at the Port of New Bedford for staging and loadout. Port expansion for offshore wind has been completed. The Vineyard Wind 1 Project would provide an economic return for the port's investment and would support jobs and businesses in downtown New Bedford. Construction would also provide commerce for other ports within the study area. Operation of the Vineyard Wind 1 Project facility would provide business for the harbor marine support businesses near Vineyard Haven, where the operations center would be located, as well as the Port of New	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include greater economic activity and increased employment at the Port of New Bedford (and to a lesser degree, near Vineyard Haven), due to the demand for ship maintenance services and related supplies, vessel berthing, loading and unloading, warehousing, and fabrication facilities for offshore wind components and other related business activity related to offshore wind. This would have long-term, **minor beneficial** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would contribute similar types of impacts as the Proposed Action at numerous ports. Future offshore wind activities would also have similar contributions as the Proposed Action, but in a wider range of ports. Cumulative impacts on demographics, employment, and economics from this sub-IPF would most frequently occur near the Port of New Bedford, which was upgraded specifically to support the offshore wind energy industry, but also at other ports in the geographic analysis area for demographics, employment, and economics. A trained and skilled workforce for the offshore wind industry would cumulatively

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			(concentrated in Atlantic states but also including other areas of the United States).	Bedford. This would have long-term, **minor beneficial** impacts on demographics, employment, and economics.	contribute to beneficial economic activity in port communities and in the region as a whole, and would constitute a long-term, **moderate beneficial** impact.
Port utilization: Maintenance/ dredging	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. As ports expand, maintenance dredging of shipping channels is expected to increase.	Ports would need to perform maintenance and upgrades over the next 30 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.	Maintenance and dredging to support offshore wind development would be beneficial to port usage and economic activity. The South Fork Wind Project would like to dredge the O&M facility to be established on Long Island. Risk would increase during maintenance over the 30-year period.	The Proposed Action is not considering maintenance dredging at this time; therefore, there would be no direct and indirect impacts.	The Proposed Action would not contribute to impacts on demographics, employment, and economics from this sub-IPF. Ongoing activities and future non-offshore wind activities that lead to maintenance dredging would contribute increased economic activity due to improved port access for commercial shipping, passenger vessels, and commercial fishing. Future offshore wind activities would have similar contributions as ongoing non-wind activities in ports used to support the offshore wind industry. Because the Proposed Action would not contribute direct impacts, there would be no cumulative impacts on demographics, employment, and economics from this sub-IPF.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. The likelihood of allisions is expected to continue at or near current levels.	Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.	Wind energy project structures would add up to 775 WTGs and 20 ESPs, increasing the potential for vessels to allide with structures, which would affect the businesses that operate commercial or for-hire fishing vessels and commercial recreation vessels such as tour boats. Vessel operators may take longer routes to navigate around or through offshore wind facilities to avoid allision, which would affect their fuel costs, operating time, and revenue. The impacts would increase as additional wind energy projects limit the ocean surface available for transiting and fishing, and would become constant once all potential wind energy projects are in operation.	The Proposed Action would add up to 57 WTGs and 2 ESPs, increasing the potential for vessels to allide with structures, which would affect the businesses that operate commercial or for-hire fishing vessels and commercial recreation vessels such as tour boats. Vessel operators may take longer routes to navigate around or through offshore wind facilities to avoid allision, which would affect their fuel costs, operating time, and revenue. This would have continuous, long-term, and **minor** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include a long-term increased risk of allision for vessels in the proposed Project area, due to the presence of up to 59 offshore wind energy structures. Allisions with a WTG or an ESP could result in damage to vessels, injury to crews, engagement of USCG SAR, and vessel fuel spills. This would have continuous, long-term, **minor** impacts on demographics, employment, and economics. Allision risks associated with ongoing activities and future non-offshore wind activities would remain stable over the next 30 years. Future offshore wind activities would also increase the risk of allision, at a larger scale than the Proposed Action, due to the potential for up to 774 WTGs and 20 ESPs. Cumulative impacts on demographics, employment, and economics from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, and would thus be continuous, long-term, and **moderate**.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. Such loss and damage are direct costs for gear owners, and are expected to continue at or near current levels.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	The presence of up to 775 WTGs and 20 ESP foundations, along with hard cover for scour and cable protection add up to 1,029 acres (4.2 km^2) of hard coverage which would increase the risk of gear loss connected with cable mattresses and structures along the East Coast, which would increase indirect economic impacts on the commercial and for-hire recreational fishing industries.	The presence of up to 57 WTGs, 2 ESPs, and approximately 109 acres (0.4 km^2) of hard coverage associated with the Proposed Action would increase the risk of gear loss connected with cable mattresses and structures along the East Coast, which would increase indirect economic impacts on the commercial and for-hire recreational fishing industries. This would have intermittent, short-term, **negligible** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include indirect, periodic, long-term, economic impacts resulting from direct impacts on the commercial fishing industry from gear loss and entanglement with the Proposed Action's 59 offshore structures and use of concrete mattresses to cover some cable segments. This would have intermittent, short-term, **negligible** impacts on demographics, employment, and economics. Impacts from gear loss and entanglement associated with ongoing activities and future non-offshore wind activities would remain stable over the next 30 years. Future offshore wind activities would also increase the risk of gear loss and entanglement, at a larger scale than the Proposed Action, due to the potential for up to 775 WTGs and 20 ESPs and additional use of concrete mattresses. Cumulative impacts on demographics, employment, and economics from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, thus affecting a larger portion of the commercial and for-hire recreational fishing industry, and would thus be continuous, long-term, and **moderate**.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these locations, which may be known as fish aggregating devices (FADs). Recreational and commercial fishing can occur near the FADs, although recreational fishing is more popular, because commercial mobile fishing gear is more likely to snag on FADs.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	Up to 413 acres (1.7 km^2) of hard coverage for future offshore wind foundations could encourage fish aggregation and/or generate reef effects that attract recreational fishing vessels. These structures would be less likely to attract commercial fishing vessels, due to differences in fishing techniques. This attraction would likely be limited to the minority of recreational fishing vessels that already travel as far from shore as the wind energy facilities, but could potentially result in broad changes in recreational fishing practices if fish attraction and reef effects are widespread enough to encourage more participants to travel farther from shore.	Approximately 109 acres (0.4 km^2) of hard coverage for the Proposed Action's WTGs and ESPs could encourage fish aggregation and/or generate reef effects that attract recreational fishing vessels from the proposed 59 foundations. These structures would be less likely to attract commercial fishing vessels due to differences in fishing techniques. This attraction would likely be limited to the minority of recreational fishing vessels that already travel as far from shore as the wind energy facilities. This would have long-term, **negligible beneficial** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include limited increases in recreational fishing activity (and associated economic activity) associated with fish aggregation and reef effects that could occur at some of the Proposed Action's 59 offshore structures. This would have long-term, **negligible beneficial** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Cumulative impacts on demographics, employment, and economics from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, thus affecting a larger portion of the commercial and for-hire recreational fishing industry, and would thus be long-term, **minor beneficial** impacts.
Presence of structures: Habitat conversion	Structures, including foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented species thus benefit on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	Up to 413 acres (1.7 km^2) of hard coverage for future offshore wind foundations could create foraging opportunities for seals and small odontocetes (toothed whales), possibly attracting private or commercial recreational sightseeing vessels. As a result, the presence of new habitat could increase economic activity associated with offshore sightseeing. New structures would be added intermittently over an assumed 6- to 10-year period and could benefit structure-oriented species as long as the structures remain.	Approximately 109 acres (0.4 km^2) of hard coverage for the Proposed Action's WTGs and ESPs could create foraging opportunities for seals, small odontocetes, and sea turtles, possibly attracting private or commercial recreational sightseeing vessels. As a result, the presence of new habitat could increase economic activity associated with offshore sightseeing. This would have long-term, **negligible beneficial** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include increased sightseeing vessel activity (and associated economic activity) in the proposed Project area if marine mammals were attracted to any reef-like habitats created by WTG and ESP foundations. This would have long-term, **negligible beneficial** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Cumulative impacts on demographics, employment, and economics from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, thus affecting a larger portion of the commercial and for-hire recreational fishing industry, and would thus be long-term, **minor beneficial** impacts.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore	Vessel traffic, overall, is not expected to meaningfully increase over the next 30 years. The presence of navigation	Increased navigational complexity of navigating through offshore wind facilities (totaling up to 775 WTGs and 20 ESPs) would affect marine businesses	See Section 3.13. Increased navigational complexity of navigating through the Proposed Action's 57 WTGs and 2 ESPs would affect marine	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include increased expenditures on training and increased travel time for commercial/for-hire fishing businesses, tour boats, and other marine businesses that must transit through or operate

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure and each other.	hazards is expected to continue at or near current levels.	adding time, fuel costs, and risk, and requiring adequate technological aids and trained personnel for safe navigation. Impacts would increase as each facility is built and completed starting in 2021 and continuing through 2030.	businesses, adding time, fuel costs, and risk, and requiring adequate technological aids and trained personnel for safe navigation. This would have continuous, long-term, **minor** impacts on demographics, employment, and economics.	within the proposed Project area. This would have continuous, long-term, **minor** impacts on demographics, employment, and economics. Impacts from navigation hazards associated with ongoing activities and future non-offshore wind activities would remain stable over the next 30 years. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Cumulative impacts on demographics, employment, and economics from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, thus affecting a larger portion of the commercial and for-hire recreational fishing industry with up to 794 foundations, and would thus be long-term and **moderate**.
Presence of structures: Space use conflicts	Current structures do not result in space use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	Offshore wind energy structures could affect established sailboat races (including, but not limited to, the Transatlantic Race and the Marion to Bermuda Race), tour boat routes, for-hire recreational boating and fishing, and commercial fishing locations and techniques. The geographic analysis area of impacts would increase as additional wind energy facilities are completed.	The Proposed Action's WTGs and ESPs could affect established sailboat races (including, but not limited to, the Transatlantic Race and the Marion to Bermuda Race), tour boat routes, for-hire recreational boating and fishing, and commercial fishing locations and techniques. This would have long-term, **minor** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include increased travel time and associated expenditures for commercial/for-hire fishing businesses, tour boats, and other marine businesses seeking new operating areas and transit routes due to the presence of the Proposed Action's structures. This would have long-term, **minor** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Cumulative impacts on demographics, employment, and economics from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, thus affecting a larger portion of the commercial and for-hire recreational fishing industry, and would thus be long-term and **moderate**.
Presence of structures: Viewshed	No existing offshore structures are within the viewshed of the WDA except buoys.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	See Section 3.10. Economic impact would be indirect, resulting from impacts on businesses serving the recreation and tourism industry; these would be permanent impacts over 30 years. With full build-out of the RI and MA Lease Areas, portions of up to 775 WTGs could potentially be visible from parts of the mainland, Block Island, Martha's Vineyard, and Nantucket, depending on atmospheric conditions and viewing location. The Block Island Wind facility has resulted in businesses offering boat tours for visitors and local residents desiring a close-up view of the wind turbines.	See Section 3.10. Economic impacts of the Proposed Action would be indirect, resulting from impacts on businesses serving the recreation and tourism industry. Portions of all of the Proposed Action's WTGs could potentially be visible on the horizon from certain beaches and coastal locations on Martha's Vineyard, Nantucket, and Cape Cod, depending on atmospheric conditions and viewing location. WTGs would be visible to recreational boaters, but boaters could choose their route to avoid waters where the WTGs are visible, if desired. Vineyard Wind 1 Project construction could prompt boat tours, similar to those available for the Block Island Wind facility. This would have continuous, long-term, **negligible** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would be indirect, resulting from impacts on businesses serving the recreation and tourism industry caused by the possible visibility of portions or all of the Proposed Action's WTGs and associated nighttime lighting from some beaches and coastal locations on Martha's Vineyard, Nantucket, and Cape Cod. The presence of these structures could potentially influence decisions made by visitors in selecting activities, facilities, and lodging, as well as potential residents selecting home locations. This would have continuous, long-term, **negligible** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would not contribute (or would contribute imperceptibly) to this sub-IPF. Impacts from future offshore wind activities would be similar to those of the Proposed Action, due to the possible visibility of portions of up to 775 WTGs visible from the same locations as the Proposed Action, as well as additional coastal locations in Massachusetts and Rhode Island. Cumulative impacts on demographics, employment, and economics from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease areas And Would Remain Continuous, Long-Term, And **Negligible.**
Presence of structures: Transmission cable infrastructure	The existing offshore cable infrastructure supports the economy by transmitting electric power and communications between mainland and islands. Additional communication cables run between the U.S. East Coast and European countries along the eastern Atlantic.	See Table 3.1.18-1, Other Uses: No known proposed structures not associated with offshore wind development are reasonably foreseeable.	Installation of offshore cables for each offshore wind energy facility would require temporary rerouting of all vessels away from areas of active construction. These activities would temporarily affect the commercial fishing, recreation, tourism, and marine shipping industries due to temporary displacement of economic activity. During operations, periodic maintenance could have similar impacts, although these activities would be less frequent and extensive than installation. Permanent impacts would be limited to possible hindrances to certain commercial fishing methods based on offshore cable coverage methods. Onshore cable installation could require rerouting of vehicular traffic or could briefly affect access to businesses (similar to other utility installations) resulting in temporary inconvenience.	Economic impact from the Proposed Action would result from impacts on commercial fishing, recreation, tourism, and marine shipping industries. Vessel traffic would need to temporarily avoid the portions of the OECC route undergoing active construction. The New Hampshire Avenue landfall would require an OECC route through Lewis Bay, one of the densest marine traffic areas in the study area for ferry and recreational vessels; however, the use of the Covell's Beach landfall would avoid these impacts. Onshore cable installation would result in temporary road delays and temporary disturbance of public beach during landfall installation. During operations, vessels would need to avoid areas of temporary maintenance and repair. For onshore cable, occasional road disturbance would result from repairs and maintenance. This would have localized, short-term, **minor** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include temporary disruptions of shipping traffic, commercial fishing, ferries, and recreational and tourist-related vessels in the installation or maintenance/repair area and a temporary reduction in economic activity near onshore installation sites, including beaches and roads along the onshore cable route. This would have localized, short-term, **minor** impacts on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action along cable routes associated with individual offshore wind energy facilities. Cumulative impacts on demographics, employment, and economics from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be localized, short-term, and **minor**, and only occur where installation or maintenance/repair occurs simultaneously for multiple projects, and are thus expected to be rare.
Traffic: Vessels	See Section 3.13. Study area ports and marine traffic related to shipping, fishing, and recreation are important to the region's economy. No substantial changes are anticipated to existing vessel traffic volumes.	New vessel traffic near the study area would be generated by proposed barge routes and dredging demolition sites over the next 30 years. Marine commerce and related industries would continue to be important to the study area economy.	Substantial, beneficial economic activity would result from the demand for vessels, crews, berths, and related support businesses. Offshore wind development would support ports and shipping-related industries and businesses. Business would increase during development, and a lower level of activity would be sustained during operations.	Short-term, **minor beneficial** economic activity would result from the demand for vessels, crews, berths, and related support businesses for Vineyard Wind 1 Project construction, supporting the port and marine businesses at New Bedford. Long-term, **negligible beneficial** economic activity would result from operations at New Bedford and Vineyard Haven.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include new, short-term, **minor beneficial** economic activity during construction and long-term, **negligible beneficial** economic activity during operations for ports, marine transportation, and supporting businesses, specifically in New Bedford and Vineyard Haven. Ongoing activities and future non-offshore wind activities such as proposed barge routes and dredging would also contribute new economic activity. Future offshore wind activities would have similar contributions as the Proposed Action, but in a wider range of ports. Cumulative impacts on demographics, employment, and economics from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be similar to those for the Proposed Action, and would occur at ports used to support wind energy projects throughout the geographic analysis area for

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
					demographics, employment, and economics, and would thus have **minor to moderate beneficial** impacts.
Traffic: Vessel collisions	The region's substantial marine traffic may result in occasional vessel collisions, which would result in costs to the vessels involved. The likelihood of collisions is expected to continue at or near current rates.	No substantial changes anticipated.	Offshore wind activity could result in vessel traffic congestion, with increased risk of collisions at ports used to support offshore wind development. Collisions could result in damage to vessels, injury to crews, engagement of USCG SAR, and vessel fuel spills, which could have adverse economic impact.	Increased vessel traffic at the Port of New Bedford (and to a lesser degree in open ocean between New Bedford and the WDA) during construction could increase risk of collisions. Vessel traffic during operations would be modest in volume. Collisions could have adverse economic impact. This would have localized, short-term, **minor** impacts on demographics, employment, and economics during construction (**moderate** if the New Hampshire Avenue cable landing site and the OECC route through Lewis Bay are selected) and decommissioning, and localized, long-term, **negligible** impacts during operation.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include a long-term increased risk of collisions for vessels in the WDA, due to the presence of up to 59 offshore wind energy structures and the need for corresponding maneuvers to avoid these structures. Collisions could result in damage to vessels, injury to crews, engagement of USCG SAR, and vessel fuel spills. This would have localized, short-term, **minor** impacts on demographics, employment, and economics during construction and decommissioning, and localized, long-term, **negligible** impacts during operation. Collision risks associated with ongoing activities and future non-offshore wind activities would remain stable over the next 30 years. Future offshore wind activities would also increase the risk of collision at a larger scale than the Proposed Action, due to the installation of wind energy structures throughout the RI and MA Lease Areas. Cumulative impacts on demographics, employment, and economics from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, and would continue to have localized, short-term, **minor**, impacts on demographics, employment, and economics during construction and decommissioning, and localized, long-term, **negligible** impacts during operation.
Land disturbance: Onshore construction	Onshore development activities support local population growth, employment, and economies. Disturbances can cause temporary, localized traffic delays and restricted access to adjacent properties. The rate of onshore land disturbance is expected to continue at or near current rates.	Onshore development projects would be ongoing in accordance with local government land use plans and regulations.	Offshore wind development would result in onshore cable installation and substation construction or expansion. In addition, potential improvements or expansions at study area ports, such as improvements at the Marine Commerce Terminal, could be undertaken to support multiple wind energy projects.	Temporary road and beach disturbance would result from Vineyard Wind 1 Project onshore cabling construction. The substation is in an industrial area and construction would not affect other businesses or roads. Land disturbance would have localized, short-term, **minor** impacts on demographics, employment, and economics.	The impacts on demographics, employment, and economics from this sub-IPF under the Proposed Action would include temporary disturbance of businesses adjacent to roads where the onshore cable would be installed, as well as increased economic activity for local businesses that participate in construction. This would have localized, short-term, **minor** impacts on demographics, employment, and economics. Impacts associated with ongoing activities and future non-offshore wind activities would remain stable over the next 30 years. Future offshore wind activities would have similar contributions as the Proposed Action, but in a wider range of onshore installation locations. Cumulative impacts on demographics, employment, and economics from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would only occur if onshore construction of multiple projects occurs simultaneously and in a similar location, and would have localized, short-term, **minor** impacts. In particular, land disturbance impacts would only be cumulative near the Marine Commerce Terminal or other study area ports, if multiple wind energy projects require port upgrade or expansion.
Climate change: Warming and sea level rise, storm severity/ frequency, property and infrastructure damage	Climate models predict climate change if current trends continue. Climate change has adverse implications for demographics and economic health of coastal communities, due in part to the costs of resultant damage to property and infrastructure, fisheries and other natural resources, increased disease frequency, and sedimentation, among other factors.	Onshore projects that reduce air emissions could contribute to the effort to limit climate change. Onshore solar and wind energy projects, although producing less energy than potential offshore wind developments, would also provide incremental reductions.	Increased storm severity and frequency would result in potential property loss or damage to property and infrastructure, increased insurance costs, and reduced economic viability of coastal communities. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce the socioeconomic impacts of storm severity/frequency.	The Vineyard Wind 1 Project would provide a small, direct and indirect contribution to reduction of emissions, resulting in a long-term, **negligible beneficial** impact on demographics, employment, and economics. See Appendix A Section A.8.1.	See Appendix A Section A.8.1. The impacts on demographics, employment, and economics from this IPF under the Proposed Action would include a small reduction in or avoidance of emissions from power generation resulting in a long-term, **negligible beneficial** impact on demographics, employment, and economics. Ongoing activities and future non-offshore wind activities would have similar impacts as the Proposed Action. Future offshore wind activities would have similar contributions as the Proposed Action, but at a larger scale. Cumulative impacts on demographics, employment, and economics from this IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be the same as the Proposed Action, but at a greater scale, due to the combined impacts of the Proposed Action, ongoing activities and non-offshore wind activities, and other future offshore wind activities, and would thus have long-term, **minor beneficial** impacts.
Climate change: Ocean acidification			Increased ocean acidification would result in potential impacts on all ocean-based economic activities. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce the socioeconomic impacts of ocean acidification.		
Climate change: Warming and sea level rise, altered habitat/ecology			Altered habitats and ecology would result in potential impacts on all ocean-based economic activities. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce the socioeconomic impacts of altered habitats and ecology.		
Climate change: Warming and sea level rise, altered migration patterns			Altered migration patterns would result in potential impacts on all ocean-based economic activities. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce the socioeconomic impacts of altered migration patterns.		
Climate change: Warming and sea level rise, increased disease frequency			Increased disease frequency in marine species would result in potential impacts on all ocean-based economic activities. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce the socioeconomic impacts of increased disease frequency.		

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Climate change: Warming and sea level rise, protective measures (barriers, sea walls)			Sea level rise and increased storm severity and frequency would result in the need for additional protective measures. Construction of barriers and sea walls would generate employment, but would require substantial public funding. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce the need for public spending on protective measures.		
Climate change: Warming and sea level rise, storm severity, frequency, sediment erosion, deposition			Erosion and deposition could damage infrastructure, buildings, beaches, and coastal land, leading to increased insurance costs, adverse impacts on recreation and tourism, and reduced economic viability of coastal communities. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce economic impacts associated with sediment erosion and deposition.		

ADLS = Aircraft Detection Light System; BOEM = Bureau of Ocean Energy Management; Btu = British thermal unit; EIS = Environmental Impact Statement; ESP = electrical service platform; FADs = fish aggregating devices; FCC = Federal Communications Commission; G&G = Geological and Geophysical; GW = gigawatts; IPF = impact-producing factors; km^2 = square kilometers; MA = Massachusetts; NA = not applicable; NOAA = National Oceanic and Atmospheric Administration; O&M = operations and maintenance; OECC = Offshore Export Cable Corridor(s); RI = Rhode Island; SAR = search and rescue; SEIS = Supplemental Environmental Impact Statement; USCG = United States Coast Guard; WDA = Wind Development Area; WTG = wind turbine generator

Table 3.8-1: Summary of Activities and the Associated Impact-Producing Factors for Environmental Justice

Baseline Conditions: The area of analysis for cumulative impacts on environmental justice includes counties where proposed Vineyard Wind 1 Project onshore infrastructure and potential ports are located as well as counties in closest proximity to the WDA (Barnstable, Bristol, Dukes, and Nantucket counties, Massachusetts; and Providence and Washington counties, Rhode Island) (Appendix A, Figure A.7-7).

Environmental justice communities that meet both USEPA and statewide criteria occur in counties where the proposed Project facilities would be located, as well as in or near the communities where impacts associated with construction and installation, operations and maintenance, and decommissioning activities may occur. Appendix F.2, Environmental Justice, of the Draft EIS provides maps of environmental justice communities in these areas. The environmental justice communities in the screened Massachusetts counties are most commonly clustered around larger cities and towns, including Hyannis, New Bedford, and Fall River. Environmental justice communities are present on Nantucket near the communities of Cisco, and near the airport and on Martha's Vineyard in Vineyard Haven and near Aquinnah. Additional environmental justice communities occur in Cape Cod and scattered throughout southeastern Massachusetts. Outside Massachusetts, environmental justice communities are found clustered around Providence and Newport, Rhode Island.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Air emissions: Construction/ decommissioning	Ongoing population growth and new development within the analysis area is likely to increase traffic with resulting increase in emissions from motor vehicles. Some new industrial development may result in emissions-producing uses. At the same time, many industrial waterfront areas near environmental justice communities are losing industrial uses, and converting to more commercial or residential uses.	New development may include emissions-producing industry and new development that would increase emissions from motor vehicles. Some historically industrial waterfront locations will continue to lose industrial uses, with no new industrial development to replace it. Cities such as New Bedford are promoting start-up space and commercial uses to re-use industrial space.	See Section A.8.1 and Table A-7 in Appendix A. Increased port activity during construction would generate short-term, variable increases in air emissions from engines (vessels, trucks, equipment) that could have disproportionate impacts on environmental justice communities. Several of the ports within the analysis area that could be used for offshore wind staging and shipping (the ports of New Bedford, Providence, and Quonset-Davisville) are within or close to environmental justice communities.	See Section A.8.1 and Table A-7 in Appendix A. Construction of the Proposed Action would primarily use the MCT in the Port of New Bedford and could also use the ports of Providence and Quonset-Davisville, which are within or near environmental justice communities. Increased short-term and variable emissions from Proposed Action construction operations would have **negligible** disproportionate adverse impacts on these communities near the ports. In New Bedford, existing and planned land uses buffer residential neighborhoods from port impacts.	The impacts on environmental justice communities from this sub-IPF under the Proposed Action would include short-term, variable air emissions from the Port of New Bedford that would have **negligible** impacts on environmental justice populations due to distance from, and buffers for, the neighborhoods closest to the port. Ongoing activities and future non-offshore wind activities would result in increased air emissions, which may disproportionately affect environmental justice communities. Future offshore wind activities would have similar contributions to the Proposed Action, but for additional neighborhoods near other ports used to support wind energy facility development. Cumulative, variable, **negligible** to **minor** impacts on environmental justice communities would occur, with the higher impacts occurring if multiple projects generate air emissions at the same ports near environmental justice neighborhoods.
Air emissions: Operations and maintenance	Ongoing population growth and new development within the analysis area is likely to increase traffic with resulting increase in emissions from motor vehicles. Some new industrial development may result in emissions-producing uses. At the same time, many industrial waterfront areas near environmental justice communities are losing industrial uses, and converting to more commercial or residential uses.	New development may include emissions-producing industry and new development that would increase emissions from motor vehicles. Some historically industrial waterfront locations will continue to lose industrial uses, with no new industrial development to replace it. Cities such as New Bedford are promoting start-up space and commercial uses to re-use industrial space.	See Section A.8.1 and Table A-7 in Appendix A. Increased port activity during operations would generate long-term, variable increases in air emissions from engines (vessels, trucks, equipment); however, the volume of vessel traffic and port activity related to operations are anticipated to be low, and the offshore wind industry may replace other industries no longer operating near ports. Several of the ports within the analysis area that could be used for vessel traffic related to operations are within or near environmental justice communities.	See Section A.8.1 and Table A-7 in Appendix A. The Proposed Action operations would use the ports of Vineyard Haven on Martha's Vineyard and the Port of New Bedford. Both are near environmental justice communities. Vessel trips and portside work related to operations are anticipated to be low in frequency, and air emissions would not be substantially different from the background levels of port activity. Air emissions would have **negligible** adverse impacts on environmental justice communities.	The Proposed Action would have **negligible** impacts on environmental justice communities from this sub-IPF. Ongoing activities and future non-offshore wind activities would result in increased air emissions, which could disproportionately affect environmental justice communities. Future offshore wind activities would have similar contributions as the Proposed Action, and thus would not contribute disproportionate impacts on environmental justice communities from this sub-IPF. Because the air emissions during operations and maintenance would be low, **negligible** cumulative impacts on environmental justice communities are anticipated from this sub-IPF.
Light: Structures	Offshore buoys and towers emit low-intensity light, while onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.	The view of nighttime lighting from offshore structures could affect the decisions of potential tourists or visitors in selecting coastal locations to visit. Resultant impacts on tourism-related businesses, if any, would not be anticipated to result in a long-term, detrimental impact on the recreation and tourism industry as a whole, and therefore would be unlikely to disproportionately affect the low-income employees of these businesses. The number of visible lights would	Vineyard Wind has voluntarily committed to implementing ADLS (as described in Draft EIS Section 3.4.1.3), which would activate the Proposed Action's WTG lighting when aircraft approach the Vineyard Wind 1 Project WTGs, which is expected to occur less than 0.1 percent of annual nighttime hours. When illuminated, lights from all of the Proposed Action's WTGs would be visible from certain coastlines and overlooks on Nantucket, Martha's Vineyard, and Cape Cod, depending on atmospheric conditions and exact viewing location. The visibility of nighttime lighting from certain locations could affect decisions of potential tourists or	The impacts on environmental justice populations from this sub-IPF under the Proposed Action would be indirect, resulting from effects on low-income workers that arise if businesses serving the tourism industry experience adverse impacts from nighttime lighting on WTGs. The presence of these structures could potentially influence decisions made by visitors in selecting activities, facilities, and lodging. This would have long-term, localized, **negligible** impacts on environmental justice populations. Ongoing activities and future non-offshore wind activities would generate increased onshore and nearshore lighting. Future offshore wind activities would have similar contributions as the Proposed Action over a wider area. Cumulatively, the impacts on environmental justice

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			increase during construction as additional structures are commissioned, resulting in lights from up to 709 WTGs visible from shorelines in the analysis area for environmental justice.	visitors in selecting coastal locations to visit. Impacts on tourism-related businesses, if any, would not be anticipated to result in a long-term, detrimental impact on the recreation and tourism industry within the study area as a whole, and therefore would be unlikely to have disproportionate impacts on the low-income employees of these businesses. As a result, the Proposed Action would have a continuous, long-term, **negligible** adverse impact on environmental justice communities.	populations (specifically low-income workers in the tourism industry) from this sub-IPF would be long term, constant, **negligible**, and localized, due to the limited coastal viewing area for offshore WTG lights.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors. Six existing power cables are in the analysis area. Refer to Appendix A for details.	The FCC has two pending submarine telecommunication cable applications in the North Atlantic. Future new cables, perhaps including those connecting Martha's Vineyard and/or Nantucket to the mainland, would disturb the seafloor and cause temporary increases in suspended sediment, resulting in infrequent, localized, short-term impacts over the next 30 years.	Cable installation for each project could result in short-term impacts on low-income employees of commercial/for-hire fishing businesses by reducing revenue and increasing costs for these businesses during installation due to the need to relocate away from work areas, the disruption of fish stocks, and the prevention of fixed gear deployment in work areas (Section 3.11).	See Sections 3.10.2 and 3.11.2. Cable installation could have short-term impacts on low-income employees of commercial/for-hire fishing businesses by reducing income and increasing costs during installation. Marine operators would need to relocate away from the 61- to 69-mile (depending on the landfall location selected) Vineyard Wind 1 Project OECC work area. Cable installation would disrupt fish stocks and prevent fixed gear deployment in the work area. If the New Hampshire Avenue landfall location is selected, cable installation within the densely traveled marine environment of Lewis Bay could affect low-income residents who depend on subsistence fishing or income from commercial/for-hire fishing or marine recreation. Installation would have short-term, **minor**, localized, adverse impacts on environmental justice populations that rely on subsistence fishing or employment/income from marine businesses, except that the New Hampshire Avenue landfall site would have a **moderate** to **major** impact, depending on mitigation. Maintenance of offshore cables would have long-term, isolated, **negligible** impacts.	The impacts on environmental justice from this IPF under the Proposed Action would include impacts on low-income workers due to temporary, localized hindrances to commercial/for-hire fishing businesses during cable emplacement and periodic disturbance of commercial fishing when maintenance is needed. Overall, the IPF would have **minor**, indirect, localized, and both short- and long-term impacts on environmental justice populations, except that the impact within Lewis Bay for the New Hampshire Avenue landfall site would be **moderate to major**. Ongoing activities and future non-offshore wind activities would contribute similar types of impacts, especially along the potential routes of cables, perhaps connecting Martha's Vineyard and/or Nantucket to the mainland. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Cumulatively, the impacts on environmental justice populations from this IPF would be localized, temporary, and **minor**, with the exception of the **moderate to major** impacts in the vicinity of Lewis Bay if the New Hampshire Avenue landfall site is used.
Noise: Operations and maintenance	Offshore operations and maintenance of existing wind energy projects generates negligible amounts of noise.	There are no reasonably foreseeable offshore facilities that would generate noise from operations/maintenance.	See Sections 3.7.1, 3.10.1, and 3.11.1. Operational noise is not anticipated to affect businesses or economic activity. Vessel activity at ports may increase slightly due to operations and maintenance, with a proportional increase in noise in the vicinity of environmental justice communities.	See Sections 3.7.2, 3.10.2, and 3.11.2. Operational noise is not anticipated to impact businesses or economic activity. Specific noise contributions due to port activity at the Port of New Bedford, Providence, and Quonset-Davisville on environmental justice communities are anticipated to be negligible.	The Proposed Action would contribute **negligible** direct and indirect impacts on environmental justice communities from this sub-IPF, because operational noise would not be extensive or intense enough to disproportionately affect environmental justice communities or industries that employ low-income community members. Ongoing activities and future non-offshore wind activities generate negligible amounts of offshore noise. Future offshore wind activities would have similar impacts as the Proposed Action: possible noise at ports, with direct impacts on environmental justice communities, and insufficient noise to affect industries that employ low-income community members. The Proposed Action and future offshore wind activities would have **negligible** cumulative indirect impacts on businesses and **negligible** direct impacts on environmental justice communities near ports.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the analysis area other than ongoing activities.	See Section 3.5.1, 3.10.1, and 3.11.1. To the degree that noise affects offshore businesses (commercial and for-hire recreational fishing, boating, and sightseeing, etc.), and subsistence activities, these impacts could disproportionately affect low-income residents and employees of marine-dependent businesses.	See Sections 3.5.2, 3.10.2, and 3.11.2. To the degree that noise from the Proposed Action affects offshore businesses (commercial and for-hire recreational fishing, boating, and sightseeing, etc.) and subsistence activities, these impacts could disproportionately affect low-income residents and employees of marine-dependent businesses. The Proposed Action is anticipated to have short-term, indirect, **negligible** impacts on the members of environmental justice populations who rely on subsistence fishing or employment and income from marine businesses.	Noise from pile driving could temporarily affect fish and marine mammal populations, hindering fishing and sightseeing near construction activity within the WDA, which could discourage some businesses from operating in these areas during pile driving. This would result in an indirect, localized, short-term, **negligible** impact on low-income jobs supported by these businesses and 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 communities. Future offshore wind activities would have similar contributions as the Proposed Action over a wider area. Cumulative disproportionate impacts on environmental justice communities would be **negligible to minor**, based on the assessment of potential cumulative impacts of pile-driving on fisheries and marine mammals (Sections 3.5 and 3.11).
Noise: Trenching	Infrequent trenching for pipeline and cable laying activities emits noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	Periodic trenching would be needed over the next 30 years for repair or new installation of underground infrastructure.	See Sections 3.7.1, 3.10.1, and 3.11.1. To the degree that trenching noise for installation of offshore or onshore cables affects onshore or offshore businesses (commercial and for-hire recreational fishing, boating, and sightseeing, etc.) and subsistence activities, these impacts could disproportionately affect low-income residents and employees of businesses near onshore construction areas and marine-dependent businesses.	See Sections 3.7.2, 3.10.2, and 3.11.2. To the degree that trenching noise for installation of the Proposed Action's offshore or onshore cables affects onshore or offshore businesses (commercial and for-hire recreational fishing, boating, and sightseeing, etc.) and subsistence activities, these impacts could disproportionately affect low-income residents and employees of businesses near onshore construction areas and marine-dependent businesses. Significant impacts on onshore and marine businesses are not anticipated during the brief cable installation period. Short term, indirect, **negligible** impacts on low-income residents and employees are anticipated.	The Proposed Action would contribute short-term, indirect, **negligible** impacts on environmental justice communities from this sub-IPF. Noise from trenc89hing could temporarily hinder commercial and recreational fishing, subsistence fishing, and recreational boating near construction activity within the WDA and along the OECC route, which could discourage some businesses from operating in these areas during trenching. This would result in a short-term, localized impact on the low-income jobs supported by these industries. Ongoing activities and future non-offshore wind activities generate additional offshore trenching noise associated with sand and gravel deposits and other offshore cables. Future offshore wind activities would have similar contributions as the Proposed Action over a wider area. Cumulative disproportionate impacts would occur if trenching noise from the Proposed Action and other projects hinder commercial and recreational fishing and business activities to the point where employment for low-income community members is reduced, or if this noise reduces subsistence fishing production. Cumulative impacts on environmental justice populations would be **negligible**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Noise: Vessels	Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels (Section 3.13).	Planned new barge route and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.	See Sections 3.7.1, 3.10.1, and 3.11.1. Vessel noise is not anticipated to disproportionately affect environmental justice communities near ports, or marine businesses (commercial and for-hire recreational fishing, boating, and sightseeing, etc.), and subsistence activities. Vessel noise would be more common during construction and decommissioning, would decrease as projects are completed or decommissioned, and would remain low and variable during the operational life of proposed projects.	See Sections 3.7.2, 3.10.2, and 3.11.2. Installation would generate the most intensive vessel traffic with attendant noise at the New Bedford Port and between New Bedford and the WDA. Vineyard Wind 1 Project construction would generate an average of 7 to 18 vessel trips per day from New Bedford or other ports to the WDA, as well as the noise at the MCT from construction staging and loading. Noise from construction vessel traffic is not anticipated to directly affect environmental justice communities near the port or to have direct and indirect impacts on commercial fishing and recreational fishing/boating/boat tours. Overall, vessel noise is anticipated to have short-term, variable, direct, **negligible** impacts on environmental justice communities near the ports, and indirect, **negligible** impacts on low-income employees of marine businesses.	The Proposed Action would have direct and indirect, variable, primarily short-term, **negligible** impacts on environmental justice communities from this sub-IPF. Vessel noise is not anticipated to affect environmental justice communities near the New Bedford Port during construction due to the buffers between the port and residential neighborhoods. Vessel noise would have negligible impacts on commercial and recreational fishing and boating in the vicinity of vessel routes to and within the RI and MA Lease Areas, and near offshore cable installation sites. Interruptions would be temporary, variable, and localized. Vessel noise from ongoing activities and future non-offshore wind activities would continue at current levels. Future offshore wind activities would have similar contributions as the Proposed Action over a wider area, with cumulative, **negligible** impacts on environmental justice communities.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The MCT at the Port of New Bedford is a completed facility developed by the port specifically to support the construction of offshore wind facilities.	Ports would need to perform maintenance and upgrade facilities to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.	The Ports of New Bedford, Providence, and Quonset-Davisville Port are within or near neighborhoods with a high proportion of low income and/or minority residents. Other ports in the northeast that could support increased offshore wind energy activity may also be near environmental justice communities. Port expansion or increased activity within existing ports to accommodate offshore wind development could potentially have both beneficial impacts (through increased job availability), and negative impacts, if port expansion or increased activity leads to increased air emissions and noise.	Vineyard Wind has committed to using the MCT at the Port of New Bedford for staging and shipping project components; the terminal was built to support offshore wind. The city has established land use patterns to buffer nearby residential neighborhoods, including environmental justice populations, from the intensive port activity. Operation of the Vineyard Wind 1 Project would modestly increase vessel traffic near environmental justice populations in the vicinity of Vineyard Haven on Martha's Vineyard and the Port of New Bedford. No port expansion would occur as part of the Proposed Action. Negative impacts are noted above in the IPFs for air emissions and vessel noise.	The Proposed Action is not anticipated to contribute disproportionate indirect impacts on environmental justice communities from this sub-IPF during construction and operation based on activity levels at the Port of New Bedford and Vineyard Haven Harbor. Negative impacts are noted above in the IPFs for air emissions and noise. Ongoing activities and future non-offshore wind activities could result in disproportionate indirect impacts on environmental justice (also through direct impacts such as air pollution or noise) at multiple ports in Massachusetts and Rhode Island. Future offshore wind activities would have similar contributions as ongoing activities and non-offshore wind activities. Cumulative impacts on environmental justice communities from vessel noise and air emissions are noted above in the IPFs for air emissions and vessel noise.
Presence of structures: Entanglement, gear loss/ damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. Such loss and damage are direct costs for gear owners, and are expected to continue at or near current levels.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	See Sections 3.7.1, 3.10.1, and 3.11.1. The presence of up to 775 WTGs, 20 ESPs, and an undetermined amount of scour protection and cable mattresses from multiple wind energy facilities would cumulatively increase the risk of gear loss connected with cable mattresses and scour protection structures along the east coast, which would cumulatively increase indirect economic impacts on the commercial and for-hire recreational fishing industries. Impacts on recreational and commercial fishing businesses could have disproportionate impacts on the low-income workers in those industries.	See Sections 3.7.2, 3.10.2, and 3.11.2. Vineyard Wind's 100 WTG and 2 ESP foundations and 152 acres of scour/cable protection would increase the local risk of gear loss/damage and the ensuing impacts on recreational and commercial fishing. Impacts on recreational and commercial fishing businesses could have **minor** impacts on the low-income workers in those industries or subsistence fishing by low-income residents.	The Proposed Action would contribute **minor** indirect impacts on environmental justice communities from this sub-IPF, if WTGs, ESPs, and concrete mattresses cause gear loss or damage that results in meaningful reductions in employment or earnings for low-income employees of commercial and recreational fishing businesses, or reduced productivity of subsistence fisheries. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, over a wider area. Cumulative, **minor** impacts on environmental justice communities would occur if entanglement and gear loss from multiple projects result in meaningful reductions in employment or earnings for low-income employees of commercial and recreational fishing businesses, or reduced productivity of subsistence fisheries.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure, and each other.	Vessel traffic is generally not expected to meaningfully increase over the next 30 years. The presence of navigation hazards is expected to continue at or near current levels.	See Sections 3.10.1 and 3.11.1. Operation of up to 775 WTGs and 20 ESPs could create navigation hazards for vessels. To the degree that these hazards affect offshore businesses and subsistence activities, these impacts could disproportionately affect low-income residents and employees of marine-dependent businesses.	See Sections 3.10.2 and 3.11.2. Operation of the Proposed Action and its 100 WTGs and 2 ESPs would result in navigational hazards for recreational boaters and commercial or for-hire fishing throughout the Proposed Action's 30-year operating life. The risk of collisions or allisions could discourage mariners from traveling to and through the proposed Project area. Although the likelihood of such events would remain small, the risk of such events could affect the navigational decisions of some commercial fishing businesses that are accustomed to fishing within or travelling through the RI and MA Lease Areas, with resulting **minor** impacts on the low-income workers in the marine recreation and commercial fishing industries or subsistence fishing by low-income residents.	The Proposed Action would contribute **minor** indirect impacts on environmental justice communities from this sub-IPF due to the necessary changes in navigation patterns to avoid hazards (including structures and vessels), if those changes are significant enough to meaningfully affect subsistence fishing or the employment or income of low-income community members (e.g., due to increased fuel use or travel time). The navigational hazards generated by ongoing activities and future non-offshore wind activities would remain constant over the next 30 years. Future offshore wind activities would have similar contributions as the Proposed Action, over a wider area. Cumulative **minor** impacts on environmental justice communities would occur as structures installed by the Proposed Action and other projects increase navigational complexity and hazards, if those changes are significant enough to meaningfully affect subsistence fishing or the employment or income of low-income community members (e.g., due to increased fuel use or travel time).
Presence of structures: Space use conflicts	Current structures do not result in space use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	See Sections 3.7.1, 3.10.1, and 3.11.1. Space conflicts created by displacement of vessels from the RI and MA Lease Areas could affect offshore activities (most likely commercial and recreational fishing and recreational boating, especially businesses associated with sailboat races and HMS fishing) and subsistence activities. If these impacts hinder business activities, this could disproportionately affect low-income residents and employees of marine-dependent businesses.	See Sections 3.7.2, 3.10.2, and 3.11.2. Space conflicts created by displacement of vessels from the proposed Project area could affect offshore activities (most likely commercial and recreational fishing and recreational boating, especially businesses associated with sailboat races and HMS fishing) and subsistence activities throughout the Proposed Action's 30-year operating life. If these impacts hinder business activities, this could result in **minor** impacts on low-income residents and employees of marine-dependent businesses.	The Proposed Action would contribute **minor** indirect impacts on environmental justice communities from this sub-IPF if the presence of WTGs and ESPs displace vessels from the proposed Project area, and if the resulting competition for space (i.e., for commercial or recreational fishing or sightseeing) meaningfully affects the employment or income of low-income community members (e.g., due to increased fuel use, travel time, or lost revenue). Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action over a wider area. Cumulative **minor** impacts on environmental justice communities would likely occur due to space use conflicts caused by the presence of the Proposed Action and other projects, which could displace fishing and sightseeing vessels, and affect the employment or income of low-income community members (e.g., due to increased fuel use or travel time, or lost revenue).

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Viewshed	There are no existing offshore structures within the viewshed of the WDA except buoys.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	See Sections 3.7.1 and 3.10.1. The potential view of up to 775 offshore WTGs from locations in Massachusetts and Rhode Island could affect the decisions of potential tourists or visitors in selecting coastal locations to visit. Resultant impacts on tourism-related businesses, if any, would not result in a long-term, detrimental impact on the recreation and tourism industry as a whole, and therefore would be unlikely to disproportionately affect the low-income employees of the industry. Impacts for each project could vary depending upon location and visibility.	See Sections 3.7.2 and 3.10.2. All of the Proposed Action's WTGs could potentially be visible from certain coastlines and overlooks on Nantucket, Martha's Vineyard, and Cape Cod throughout the Proposed Action's operating life, depending on atmospheric conditions and exact viewing location. The visibility from certain locations could affect decisions of potential tourists or visitors in selecting coastal locations to visit. Impacts on tourism-related businesses, if any, would not result in a long-term, detrimental impact on the recreation and tourism industry within the study area as a whole, and therefore would be unlikely to have disproportionate impacts on the low-income employees of these businesses. The impact on environmental justice populations would be **negligible.**	The Proposed Action would contribute **negligible** indirect impacts on environmental justice communities from this sub-IPF based on the impact of visible WTGs in reducing economic activity in sectors that employ low-income residents (i.e., recreation and tourism). Ongoing activities and future non-offshore wind activities do not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action over a wider area. Cumulative impacts on environmental justice communities, as a result of visible WTGs for multiple projects, are likely to be **negligible**. Impacts would be long term, constant, and localized, due to the limited coastal viewing area for offshore WTGs.
Presence of structures: Transmission cable infrastructure	Two subsea cables that cross the far western portion of OCS-A 0487. These cables are associated with a larger network of subsea cables south of the cumulative lease areas and make landfall near Charlestown, Massachusetts. These cables are located near the Block Island Wind Farm and cross the Block Island Wind Farm export cable.	Existing cable operation and maintenance activities would continue within the analysis area.	See Sections 3.10.1 and 3.11.1. The presence of cables after installation would affect marine activities where concrete cable mattresses or scour protection make anchoring difficult for small vessels and would affect some commercial fishing methods. Impacts would be limited in area and may disproportionately affect low-income residents and employees of marine-dependent businesses. Onshore impacts would depend on the exact location of onshore transmission cables.	See Sections 3.10.2 and 3.11.2, and Tables 3.10-1 and 3.11-1. The presence of cables would have long-term, localized, indirect, **minor** impacts on environmental justice populations, resulting from limitations on marine activities (anchoring and some commercial fishing methods) where concrete cable mattresses are used, with resulting impacts on marine businesses and subsistence fishing. This impact would be limited in area. Impacts would be **moderate** if the New Hampshire landfall site is selected due to the density of marine traffic in Lewis Bay and the narrow channel into and out of the bay. Vessels would occasionally need to avoid areas of temporary cable maintenance and repair. For onshore cable, occasional road disturbance would result from repairs/maintenance, with short-term, infrequent, **negligible** impacts on environmental justice communities.	The Proposed Action would contribute indirect, localized, **minor** impacts on environmental justice communities from this sub-IPF, or **moderate** impacts within Lewis Bay if the New Hampshire Avenue landfall site is selected, due to limits on anchoring and fishing methods in areas with hard-cover protection over cables, as well as occasional disruption for repairs and the resulting impacts on low-income employees of commercial or for-hire recreational fishing or boating businesses. Cable infrastructure impacts from ongoing activities and future offshore wind activities would continue at current intensities. Future offshore wind activities would have similar contributions as the Proposed Action over a wider area. Cumulative indirect, localized, **minor** impacts on environmental justice communities would occur if the installation and maintenance of existing and future wind- and non-wind-energy cables and associated concrete mattresses affects marine businesses and their low-income workers.
Traffic: Vessels	Study area ports and marine traffic related to shipping, fishing and recreation are important to the region's economy. No substantial changes are anticipated to existing vessel traffic volumes (Section 3.13).	New vessel traffic near the study area would be generated by proposed barge routes and dredging demolition sites over the next 30 years. Marine commerce and related industries would continue to be important to the study area employment.	See Section 3.13.1. The volume of vessel traffic during construction would complicate navigation in offshore construction areas and create potential for vessel congestion and reduced capacity within and near the ports that support offshore construction, with potential competition for berths and docks. The temporary impacts on commercial fishing or recreational boating would affect all local boaters, with impacts of greater magnitude on members of environmental justice communities who depend on subsistence fishing or jobs in commercial/for-hire fishing or marine recreation. Simultaneous development of multiple offshore wind energy projects could increase port-related vessel congestion. Impacts could be reduced by appropriate port planning and preparation.	See Section 3.13.2. Construction would generate vessel traffic within and near the Port of New Bedford, and possibly the ports of Providence and Quonset-Davisville, near environmental justice communities. Construction would also add to vessel traffic in Lewis Bay if the New Hampshire Avenue cable landfall site location were selected. Vessel traffic during construction is likely to have a short-term, **minor** impact on members of environmental justice communities who rely on subsistence fishing or employment and income from commercial fishing and marine recreation, due to increased vessel traffic near ports and potential displacement from berths and docks. Modest levels of vessel traffic during operations would have **negligible** impacts on environmental justice communities.	The impacts on environmental justice populations from this sub-IPF under the Proposed Action would include short-term, variable, adverse, **negligible** impacts on low-income residents involved in the commercial fishing industry or subsistence fishing. Vessel traffic would have a long-term, **negligible** impact on environmental justice communities. Ongoing activities and future non-offshore wind activities such as proposed barge routes and dredging would contribute modestly to vessel traffic. Future offshore wind activities would have similar contributions as the Proposed Action, but in a wider range of ports and more intensively in and near ports supporting more than one offshore wind project. Cumulative impacts on environmental justice communities from this sub-IPF would be similar to those for the Proposed Action, and would occur at ports used to support wind energy projects throughout the analysis area, and would thus have **minor** adverse impacts during construction and **negligible** impacts during operations due to the impact on marine businesses and subsistence fishing.
Land disturbance: Erosion and sedimentation	Potential erosion and sedimentation from development and construction is controlled by local and state development regulations.	New development activities would be subject to erosion and sedimentation regulations.	Installation of onshore landfall equipment, cables, and substations would be subject to local and state regulations to control erosion and sedimentation. Specific impacts would depend upon location and compliance with management practices.	Installation of onshore landfall equipment, cables, and substations would be subject to local and state regulations to control erosion and sedimentation. Onshore installations, including the substation, a majority of the cable route for the Covell's Beach landfall site, and a small segment of the route for the New Hampshire Avenue landfall site, would be adjacent to neighborhoods that meet environmental justice criteria. Sediment and erosion resulting from OECR installation would have short-term, **negligible** direct impacts on environmental justice communities.	The Proposed Action would contribute **negligible** direct impacts on environmental justice communities from this sub-IPF. Ongoing activities and future offshore wind activities would affect environmental justice communities if inadequately controlled erosion and sedimentation disproportionately affect individual environmental justice communities, or if such activities affect businesses to the point where employment or earnings for low-income employees are reduced. Future offshore wind activities would have similar contributions as ongoing activities. Cumulative impacts on environmental justice communities under this sub-IPF would be **negligible**, assuming erosion and sedimentation control measures are implemented.
Land disturbance: Onshore construction	Onshore development supports local population growth, employment, and economics.	Onshore development would continue in accordance with local government land use plans and regulations.	Onshore construction for each project would be analyzed for possible disproportionate impacts of onshore construction on low income or minority populations.	Onshore installations, including the substation, a majority of the cable route for the Covell's Beach landfall site, and a small segment of the route for the New Hampshire Avenue landfall site would be adjacent to communities that meet environmental justice criteria. Construction of the OECR would temporarily disturb neighboring land uses through construction noise, vibration, dust, and delays in travel along the affected roads, but would have only short-term, variable, **negligible** impacts on environmental justice communities.	The Proposed Action would contribute **negligible** direct impacts on environmental justice communities from this sub-IPF. Ongoing activities and future offshore wind activities would affect environmental justice communities if land disturbance during onshore construction disproportionately directly affects individual environmental justice communities, or if such activities affect businesses to the point where employment or earnings for low-income employees are reduced. Future offshore wind activities would have similar contributions as ongoing activities. Cumulative impacts on environmental justice communities under this sub-IPF would be **negligible**, because onshore development would not overlap in geographic location.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Land disturbance: Onshore, land use changes	Onshore development would result in changes in land use in accordance with local government land use plans and regulations.	Development of onshore solar and wind energy would provide diversified, small-scale energy generation.	See Section 3.12.1. If new substations or other aboveground utility infrastructure were located in an area of low-income or minority populations, these components could potentially have disproportionate impacts on environmental justice communities, depending on site design, buffers, and arrangement of land uses. There is no regional cumulative impact; an analysis is needed for each individual site location.	See Section 3.12.2. The Project would not change any land uses. The location of the proposed substation adjacent to an existing substation, within an existing industrial area, would avoid displacement of or impacts on homes or businesses. Cables would be underground and existing ports would be used.	The Proposed Action would have **no impact** on environmental justice communities from this sub-IPF because there would be no land use changes. Ongoing activities and future offshore wind activities would not contribute disproportionate impacts on environmental justice communities, assuming land development occurs in accordance with local government land use plans and regulations. Future offshore wind activities would not generate disproportionate impacts if uses are located in accordance with land use plans and regulations and do not displace or adversely impact existing land uses in environmental justice communities (e.g., through reduced property value or reduced revenue for businesses that employ low-income workers). There would be **no cumulative impacts** on environmental justice communities under this sub-IPF, because the Proposed Action would not generate direct or indirect impacts on environmental justice communities.

ADLS = Aircraft Detection Light System; ESP = electrical service platform; FCC = Federal Communications Commission; G&G = Geological and Geophysical; HMS = Highly Migratory Species; IPF = impact-producing factors; MA/RI = Massachusetts/Rhode Island; MCT = New Bedford Marine Commerce Terminal; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor(s); OECR = Onshore Export Cable Route; RI and MA Lease Areas = Rhode Island and Massachusetts Lease Areas; USEPA = U.S. Environmental Protection Agency; WDA = Wind Development Area; WTG = wind turbine generator

Table 3.8-2: State and County Minority and Low-Income Status

	Non-White Population Percentage			Percentage of Population in Poverty		
Jurisdiction	**2000**	**2010**	**2016**	**2000**	**2010**	**2017**
Commonwealth of Massachusetts	15.5%	19.6%	20.6%	9.3%	10.5%	10.5%
Barnstable County	5.8%	7.3%	7.6%	6.9%	7.2%	7.6%
Bristol County	9.0%	11.6%	13.6%	10.0%	11.3%	10.7%
Dukes County	9.3%	12.4%	11.9%	7.3%	8.6%	7.6%
Nantucket County	12.2%	12.4%	14.7%	7.5%	7.2%	6.4%
State of Rhode Island	15.0%	18.6%	19.0%	11.9%	12.2%	12.8%
Providence County	21.6%	26.6%	26.7%	15.5%	15.4%	15.8%
Washington County	5.2%	6.2%	6.8%	7.3%	7.4%	9.8%

Sources: U.S. Census Bureau 2007a, 2007b, 2010, 2012, 2018; Vineyard Wind 2018b

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Table 3.9-1: Summary of Activities and the Associated Impact-Producing Factors for Cultural Resources

Baseline Conditions: Cultural resource investigations in the northeast United States have identified a wide variety of archaeological resources, historic structures, and TCPs. Previously identified onshore archaeological resources include pre-contact period Native American sites and colonial period through 20th Century European-American sites. Offshore archaeological resources include paleolandform features that have the potential to contain pre-contact period Native American sites dating to before the end of the last glacial maximum, as well as historic period shipwrecks, downed aircraft, and debris fields associated with colonial through 20th Century maritime activities. Offshore paleolandform features are also considered to be significant cultural resources to Native American tribes as the landscape formerly occupied by their ancestors. Paleolandform resources are considered contributing elements to one or more Traditional Cultural Properties (TCPs) due to their associations with the cultural practices, traditions, and beliefs of Native American tribes. Historic standing structures found across the northeastern United States include a wide variety of residential, commercial, and industrial buildings, structures, and infrastructure that date from the 16th through 20th centuries. Potential TCPs in the northeastern United States include a wide variety of locations associated with the cultural practices, traditions, beliefs, lifeways, arts, crafts, and/or social institution of Native American, European-American, and other living communities across the region.

Historic and modern residential, agricultural, commercial, industrial, and infrastructure activities and/or development across the northeastern United States have resulted in impacts on cultural resources. Any type of onshore or offshore ground/seafloor-disturbing activity (trenching, grading, excavation, plowing, anchoring, etc.) has the potential to damage or destroy onshore or offshore archaeological and TCP resources. Redevelopment of historic areas can result in physical damage or the destruction of historic structures. Construction of new, modern structures can cause direct impacts on historic structure and TCP resources through the introduction of intrusive visual (new buildings, structures, etc.) or auditory (i.e., noises) elements that affect the resources' historic, scientific, religious, and/or cultural significance/importance.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/hazmat	See Table A-8 for Water Quality for a quantitative analysis of these risks. Accidental releases of fuel/fluids/hazmat occur during vessel use for recreational, fisheries, marine transportation, or military purposes, and other ongoing activities. Both released fluids and cleanup activities that require the removal of contaminated soils and/or seafloor sediments can cause impacts on cultural resources because resources are impacted during by the released chemicals as well as the ensuing cleanup activities.	Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases within the geographic analysis area for cultural resources, increasing the frequency of small releases. Although the majority of anticipated accidental releases would be small, resulting in small-scale impacts on cultural resources, a single, large-scale accidental release such as an oil spill, could have significant impacts on marine and coastal cultural resources. A large-scale release would require extensive cleanup activities to remove contaminated materials resulting in damage to or the complete removal of terrestrial and marine cultural resources. In addition, the accidentally released materials in deep water settings could settle on seafloor cultural resources such as wreck sites, accelerating their decomposition and/or covering them and making them inaccessible/unrecognizable to researchers, resulting in a significant loss of historic information. As a result, although considered unlikely, a large-scale accidental release and associated cleanup could result in permanent, geographically extensive, and large-scale impacts on cultural resources.	In the expanded cumulative scenario, there would be a low risk of a leak of fuel, fluids, or hazmat from any of the approximately 775 WTGs and 20 ESPs. These structures would store a total of approximately 5.3 million gallons (20 million liters) of such fluids within the geographic analysis area for cultural resources. Accidental release of hazardous materials and trash/debris, if any, may pose a long-term, infrequent risk to cultural resources. The majority of impacts associated with accidental releases would be indirect, due to cleanup activities that require the removal of contaminated soils. The number of accidental releases from the future offshore wind projects, the volume of released material, and the associated need for cleanup activities would be limited due to the low probability of occurrence, the low volumes of material released in individual incidents, the low persistence time, standard BMPs to prevent releases, and the localized nature of such events. As such, the majority of individual accidental releases from future offshore wind development would not be expected to result in measurable impacts on cultural resources.	Accidental release of hazardous materials and trash/debris, if any, could affect cultural resources. The 59 WTG and ESP foundations for the Proposed Action would include storage for up to 24,157 gallons (93,715 liters) of coolants, 341,869 gallons (1.3 million liters) of oils and lubricants, and 50,897 gallons (192,666 liters) of diesel fuel. The volume of materials released is unlikely to require cleanup operations that would permanently impact cultural resources. As a result, the direct and indirect impacts of accidental releases from the Proposed Action on cultural resources would be localized, short-term, and **negligible**.	The impacts on cultural resources from this sub-IPF under the Proposed Action are unlikely to occur, and would be localized, short-term, and **negligible**. Ongoing activities and future non-offshore wind activities would likely cause a gradual increase in the frequency and amount of accidental releases. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but on a larger scale. Cumulative impacts from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would therefore be localized, short-term, and **minor**.
Accidental releases: Trash and debris	Accidental releases of trash and debris occur during vessel use for recreational, fisheries, marine transportation, or military purposes and other ongoing activities. While the released trash and debris can directly affect cultural resources, the majority of impacts associated with accidental releases occur during cleanup activities, especially if soil or sediment removed during cleanup affect known and undiscovered archaeological resources. In addition, the presence of large amounts of trash on shorelines or the ocean surface can impact the cultural value of TCPs for stakeholders. State and federal laws prohibiting large releases of trash would limit the size of any individual release and ongoing local, state, and federal efforts to clean up trash on beaches and waterways would continue to mitigate the effects of small-scale accidental releases of trash.	Future activities with the potential to result in accidental releases include construction and operations of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications).Accidental releases would continue at current rates along the northeast Atlantic coast.	Construction of offshore wind projects would increase the likelihood of accidental releases of trash; however, the volume of trash released would be unlikely to necessitate a cleanup action substantial enough to affect cultural resources.	Construction of the Proposed Action would increase the potential for accidental releases of trash; however, the small volume of released material would not require a cleanup action substantial enough to affect cultural resources. As a result, the Proposed Action would have localized, short-term, **negligible** impacts on cultural resources.	The impacts on cultural resources from this sub-IPF under the Proposed Action would be localized, short-term, and **negligible**. It is unlikely that released material would require cleanup that would affect cultural resources. Ongoing activities and future non-offshore wind activities would likely cause a gradual increase in the accidental release of trash, due to the gradual increase in commercial and recreational activities off the coast of southern New England. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but on a larger scale. Cumulative impacts from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would therefore be localized, short-term, and **minor**.
Anchoring	The use of vessel anchoring and gear (i.e., wire ropes, cables, chain, sweep on the seafloor) that disturbs the seafloor, such as bottom trawls and anchors, by military, recreational, industrial, and commercial vessels can impact cultural resources by physically damaging maritime archaeological resources such as shipwrecks and debris fields.	Future activities with the potential to result in anchoring/gear utilization include construction and operations of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); military use; marine transportation; fisheries use and management; and oil and gas activities. These activities are likely to continue to occur at current rates along the entire coast of the eastern United States.	Anchoring, gear utilization, and dredging activities would increase during the construction, maintenance, and eventual decommissioning of offshore wind energy facilities. The expanded cumulative scenario could result in up to 126 acres of seafloor in the geographic analysis area affected by anchoring that could potentially impact cultural resources. The placement and relocation of anchors and other seafloor gear such as wire ropes, cables, and anchor chains that affect or sweep the seafloor could potentially disturb shipwreck and debris field resources on or just below the seafloor surface, resulting in permanent and irreversible loss of scientific or cultural value. BOEM and relevant SHPOs would continue to require offshore wind developers to conduct geophysical remote sensing surveys of proposed development areas as part of NEPA and NHPA Section 106 compliance activities, to identify shipwreck and	Vineyard Wind's geophysical marine archaeological surveys within the WDA and along the OECC route identified two shipwrecks and five potential shipwrecks/debris fields, which Vineyard Wind has committed to avoiding during construction, maintenance, and decommissioning activities. Other undiscovered resources could potentially be impacted. As a result, the Proposed Action would have localized, long-term, **negligible** impacts on cultural resources under this IPF.	The impacts on cultural resources from this IPF under the Proposed Action would be localized, long-term, and **negligible**, due to Vineyard Wind's commitment to avoiding shipwrecks and debris field resources within the WDA. Ongoing activities and future non-offshore wind activities could cause a gradual increase in the frequency and scale of impacts on marine cultural resources from vessel anchoring and gear utilization. BOEM anticipates that lead federal agencies and relevant SHPOs would require the applicants for other offshore wind projects to conduct extensive geophysical remote sensing surveys (i.e., similar to those conducted for the Proposed Action) to identify and avoid marine cultural resources as part of NEPA and NHPA Section 106 compliance activities. As a result, impacts from future offshore wind activities would be similar to those of the Proposed Action, but on a larger scale. Cumulative impacts from this IPF associated with

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			debris field resources and implement plans to avoid these resources.		the Proposed Action when combined with past, present, and reasonably foreseeable activities would therefore be localized, short-term, and **minor**.
Gear utilization: Dredging	Activities associated with dredge operations and activities could damage marine archaeological resources. Ongoing activities identified by BOEM with the potential to result in dredging impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities.	Dredging activities would gradually increase through time as new offshore infrastructure is built, such as gas pipelines and electrical lines, and as ports and harbors are expanded or maintained.	Development of the offshore wind industry would require additional dredging, which could impact cultural and archaeological resources buried beneath the seafloor. BOEM and relevant SHPOs would continue to require offshore wind developers to conduct geophysical remote sensing surveys of proposed development areas as part of NEPA and NHPA Section 106 compliance activities, to identify and avoid and/or mitigate impacts on identified marine archaeological resources.	The Proposed Action's dredging operations could impact cultural and archaeological resources buried beneath the seafloor. Vineyard Wind's geophysical marine archaeological surveys within the WDA and along the OECC route identified two shipwrecks and five potential shipwrecks/debris fields, which Vineyard Wind has committed to avoiding during construction, maintenance, and decommissioning activities. As a result, the Proposed Action would have localized, long-term, **negligible** impacts on cultural resources under this sub-IPF.	The impacts on cultural resources from this sub-IPF under the Proposed Action would be localized, long-term, and **negligible**, due to Vineyard Wind's commitment to avoiding shipwrecks and debris field resources within the WDA. Ongoing activities and future non-offshore wind activities would likely cause a gradual increase in the frequency and scale of impacts on marine cultural resources from dredging. BOEM anticipates that lead federal agencies and relevant state historic preservation offices would require the applicants for other offshore wind projects to conduct extensive geophysical remote sensing surveys (i.e., similar to those conducted for the Proposed Action) to identify and avoid marine cultural resources as part of NEPA and NHPA Section 106 compliance activities. As a result, impacts from future offshore wind activities would be similar to those of the Proposed Action, but on a larger scale. Cumulative impacts from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would therefore be localized, short-term, and **minor**.
Light: Vessels	Light associated with military, commercial, or construction vessel traffic can temporarily affect coastal historic structures and TCP resources when the addition of intrusive, modern lighting changes the physical environment ("setting") of cultural resources. The impacts of construction and operations lighting would be limited to cultural resources on the southern shores of Martha's Vineyard, Nantucket, and possibly portions of Cape Cod, for which a nighttime sky is a contributing element to historical integrity. This excludes resources that are closed to stakeholders at night, such as historic buildings, lighthouses, and battlefields, and resources that generate their own nighttime light, such as historic districts. Offshore construction activities that require increased vessel traffic, construction vessels stationed offshore, and construction area lighting for prolonged periods can cause more sustained and significant visual impacts on coastal historic structure and TCP resources.	Future activities with the potential to result in vessel lighting impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities. Light pollution from vessel traffic would continue at the current intensity along the northeast coast, with a slight increase due to population increase and development over time.	Development of the offshore wind industry would increase the amount of offshore anthropogenic light from vessels and area lighting during the construction and decommissioning of projects (to the degree that construction occurs at night). Construction of 775 WTGs and 20 ESPs would be constructed from 2021 through 2030 across 12 different lease areas with up to 4 projects simultaneously under construction in 2022 and 2023. Some of these offshore wind projects could require nighttime construction lighting. 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 ESP sites, rather than the entire RI and MA Lease Areas. Lighting impacts would be mitigated by the distance between the light source and the resources, as well as atmospheric and environmental factors such as clouds, fog, and wave action. In addition, impacts would also be geographically limited to southern views from these resources. The significance of impacts on individual cultural resources would be determined on a resource-specific basis.	The Proposed Action may require nighttime vessel and construction area lighting during offshore construction. The lighting impacts would be short-term as they would be limited to the construction phase of the Proposed Action. The intensity of nighttime construction lighting from the Proposed Action would be limited to the individual or small number of WTGs and/or ESPS under construction 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 Martha's Vineyard and Nantucket. The perceived intensity of nighttime construction lighting would also decrease with distance from shore, and 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. Impacts would be limited to cultural resources for which a dark nighttime sky is a contributing element to their historic integrity and/or resources used by stakeholders at night, limiting the scale of impacts on cultural resources. As a result, nighttime vessel and construction area lighting from the Proposed Action would have short-term, low intensity impacts on a limited number of resources, resulting in **minor** impacts on cultural resources.	Construction of the Proposed Action may require nighttime vessel and construction area lighting during the construction of 57 WTGs and 2 ESPs within the WDA resulting in short-term, low intensity impacts on a limited number of resources, and thus **minor** impacts on cultural resources. Development of the offshore wind industry would require the construction of 775 WTGs and 20 ESPs from 2021 through 2030 across 12 different lease areas with up to 4 projects simultaneously under construction in 2022 and 2023. Some of these offshore wind projects could require nighttime construction lighting. Nighttime construction and decommissioning lighting associated with these projects would have long-term, low-intensity impacts on a limited number of resources, resulting in **minor** impacts on cultural resources. As a result, cumulative impacts from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be localized, long-term, and **minor**.
Light: Structures	The construction of new structures that introduce new light sources into the setting of historic standing structures or TCPs can result in impacts, particularly if the historic and/or cultural significance of the resource is associated with uninterrupted nighttime skies or periods of darkness. Any tall structure (commercial building, radio antenna, large satellite dishes, etc.) requiring nighttime hazard lighting to prevent aircraft collision can cause these types of impacts.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.	Required aviation warning lighting would be visible from up to 709 of the 775 WTGs assumed under the No Action Alternative. Resources impacted by structure lighting would include those for which a dark nighttime sky is a contributing element to historic integrity, including the Nantucket NHL and Nantucket Sound TCP, and the Chappaquiddick TCP. Lighting impacts would be mitigated by the distance between the light source and the resources, as well as atmospheric and environmental factors such as clouds, fog, and wave action that would further reduce the intensity of impacts. Visible lighting on the No Action Alternative's WTGs would result in long-term, continuous impacts on the cultural resources listed above. An ADLS, if	The use of standard aviation warning lights on the Proposed Action WTGs would result in long-term, continuous, **moderate** impacts on cultural resources. Vineyard Wind has committed, however, to using an ADLS as a voluntary measure to reduce operations phase nighttime lighting impacts. ADLS would only activate WTG lighting when aircraft enter a predefined airspace. For the Proposed Action, this was estimated to occur 235 times during the year, illuminating less than 0.1 percent of nighttime hours per year (Draft EIS Section 3.4.4.4). The use of ADLS by the Proposed Action would result in intermittent (rather than	The use of ADLS by the Proposed Action would result in intermittent, low-intensity, **minor** impacts on cultural resources. Light from ongoing activities and future non-offshore wind activities would likely continue at current rates. Future offshore wind projects would result in aviation warning lights visible on up to 709 of the 775 WTGs assumed under the No Action Alternative (including the Proposed Action). Operational lighting from the Proposed Action, combined with past, present, and reasonably foreseeable activities, would have a long-term, continuous, **moderate** impacts on cultural resources. An ADLS, if implemented for future offshore wind projects, would result in intermittent (rather than continuous), **minor** cumulative impacts on cultural resources.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			implemented, would reduce the amount of time that WTG lighting is visible, thus resulting in long-term, intermittent (rather than continuous), impacts on cultural resources.	continuous), low-intensity, **minor** impacts on cultural resources.	
Port utilization: Expansion	Major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The MCT was upgraded by the Port of New Bedford specifically to support the construction of offshore wind facilities. Expansion of port facilities can introduce large, modern port infrastructure into the viewsheds of nearby historic properties, impacting their setting and historical significance.	Future activities with the potential to result in port expansion impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities. Port expansion would continue at current levels, which reflect efforts to capture business associated with the offshore wind industry (irrespective of specific projects).	The Massachusetts Clean Energy Center identified 18 waterfront sites in Massachusetts that could be available and suitable for use by the offshore wind industry (MassCEC 2017a, b). Orsted has committed to improvements to Rhode Island ports in support of the Revolution Wind Project (Kuffner 2018). These port modification and expansion projects could affect historic structures and/or archaeological sites within or near port facilities. Future channel deepening by dredging that may be required to accommodate larger vessels required to carry WTG components and/or 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, and/or mitigate impacts on cultural resources, these impacts would be long-term and isolated to a limited number of cultural resources that cannot be avoided, or that were previously undocumented.	The Proposed Action would not require expansion of any port, but would make use of expansions and improvements at the MCT at the Port of New Bedford and at Vineyard Haven that were undertaken to support the wind industry overall. As a result, the Proposed Action would not contribute direct and indirect impacts on cultural resources that occurred or would occur due to these expansions.	The Proposed Action would not contribute direct and indirect impacts on cultural resources due to expansion and upgrades at the Port of New Bedford and at Vineyard Haven that were undertaken to support the wind industry overall. Ongoing and future non-offshore wind activities would include ongoing maintenance for numerous harbors within the geographic analysis area that are important for recreation and tourism. BOEM assumes that any port expansions necessitated by other offshore wind projects would also adhere to applicable regulations for evaluating and addressing impacts on cultural resources. Because the Proposed Action would have no direct and indirect impacts under this sub-IPF, there would be no cumulative impacts.
Presence of structures	The only existing offshore structures within the viewshed of the geographic analysis area are minor features such as buoys.	Non-offshore wind structures that could be viewed would be limited to meteorological towers. Marine activity would also occur within the marine viewshed of the geographic analysis area.	Portions of up to 651 of the 775 WTGs assumed under the No Action Alternative (including the Proposed Action) could potentially be visible from the three historic properties in the area of intervisibility between the Proposed Action and the future offshore wind projects: the Gay Head Lighthouse, Chappaquiddick TCP, and the Nantucket NHL—resources for which a sea view free of modern visual elements is a contributing factor to NRHP eligibility. The WTGs would appear relatively small to an observer at these resources, and the visibility of WTGs would be further reduced by environmental and atmospheric factors such as cloud cover, haze, sea spray, vegetation, and wave height. Nonetheless, the visibility of these modern structures would have long-term, continuous impacts on the cultural resources listed above.	A Historic Properties Visual Impact Assessment for the Proposed Action determined that the construction of the proposed Project's WTGs would affect the Gay Head Lighthouse; Chappaquiddick Island TCP; and the Nantucket NHL, although 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 (COP Volume III, Appendix III-H.b; Epsilon 2020). The Proposed Action would further mitigate viewshed impacts by avoiding use of the three turbine locations in the northwest corner of the WDA, using non-reflective pure white and light grey paint on offshore structures, and funding a mitigation plan to resolve impacts on the Gay Head Lighthouse. Vineyard Wind has also committed to fund specific mitigation projects on the Nantucket NHL. Nonetheless, an uninterrupted sea view free of modern visual elements is a contributing element to NRHP eligibility of the resources listed above. As a result, the presence of visible WTGs from the Proposed Action structures would have long-term, continuous, widespread, **moderate** impacts on the Gay Head Lighthouse, Chappaquiddick Island TCP, and the Nantucket NHL.	The visible presence of 57 of the Proposed Action's WTGs would have long-term, continuous, widespread, **moderate** impacts the Nantucket NHL, Gay Head Lighthouse, and Chappaquiddick TCP. Other ongoing and non-offshore wind activity would not contribute to this IPF. Up to 651 WTGs from the No Action Alternative (including the Proposed Action) could potentially be visible from select, high elevations at each of these resources. While mitigating factors would limit the intensity of impacts, the presence of visible WTGs from the Proposed Action, in combination with the No Action Alternative, would have long-term, continuous, and **moderate** cumulative impacts on the three historic properties listed above.
New cable emplacement/ maintenance	Current offshore construction activity is limited to subsea fiber optic and electrical transmission cables, including six existing power cables in the geographic analysis area.	Future activities with the potential to result in seafloor disturbances similar to offshore impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; and oil and gas activities. Such activities could cause impacts on submerged archaeological resources including shipwrecks and formerly subaerially exposed pre-contact Native American archaeological sites.	Offshore wind projects would result in the construction of 795 foundations for WTGs and ESPs and 3,398 acres (13.7 km^2) of seabed disturbance from installation of inter-array and offshore export cables. BOEM studies suggest that the RI and MA Lease Areas contain shipwreck sites and a large number of paleolandform resources (TRC 2012). Impacts on shipwreck resources can typically be avoided through project design. The number, extent, and dispersed character of the paleolandforms make avoidance difficult, while the depth of these resources makes mitigative excavations/studies difficult and expensive. It is unlikely that offshore wind projects would be able to avoid all of these resources.	The marine geophysical and geotechnical studies conducted for the Proposed Action identified two shipwrecks, five potentially significant debris fields, and 35 paleolandform features that may represent cultural resources. The Proposed Action would avoid the shipwrecks and debris fields, resulting in no impacts on these resources. The Proposed Action would be unable to avoid 19 of 35 previously identified paleolandform features. Vineyard Wind has committed to working with the consulting parties, Native American tribes, BOEM, and the MHC to develop a specific	The Proposed Action would have localized, long-term, continuous, **negligible**, impacts on shipwreck and debris field resources, and widespread, **moderate**, impacts on paleolandform features. Ongoing activities and future non-offshore wind activities would likely follow state and federal requirements to identify and avoid or mitigate impacts on marine cultural resources. Future offshore wind development would have similar impacts as the Proposed Action, over a wider area. As a result, the cumulative impacts on cultural resources under this IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be localized, long-term, continuous, and **moderate**.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			BOEM has committed to working with Applicants, consulting parties, Native American tribes, and the MHC to develop specific treatment plans to address effects on paleolandform features that cannot be avoided by proposed offshore wind development projects. Implementation of these plans would reduce the extent, intensity, and scale of impacts on paleolandform features.	treatment plan for mitigating impacts on unavoidable paleolandforms. As a result, the Proposed Action would have long-term, continuous, localized, **negligible**, impacts on shipwreck and debris field resources, and widespread, **moderate** impacts on paleolandform features.	Development and implementation of treatment plans for unavoidable paleolandform features, developed by BOEM, applicants, consulting parties, Native American tribes, and the MHC, would reduce the magnitude of impacts on paleolandform resources, but even with mitigations, the resource would not recover.
Land disturbance: Onshore construction	Onshore construction activities can impact archaeological resources by damaging and/or removing resources.	Future activities that could result in terrestrial land disturbance impacts include onshore residential, commercial, industrial, and military development activities in central Cape Cod, particularly those proximate to OECRs and interconnection facilities. Onshore construction would continue at current rates.	The construction of onshore components associated with future offshore wind projects, such as electrical export cables and onshore substations, could result in impacts on known and undiscovered cultural resources. Ground-disturbing construction activities could affect undiscovered archaeological sites, while construction of aboveground infrastructure could affect known historic structures due to the introduction of intrusive, modern, visual elements. Underground and aboveground components could also affect TCPs, if present. The number of cultural resources and/or historic properties impacted, the scale and extent of impacts, and the severity of impacts would depend on the location of specific project components relative to recorded and undiscovered cultural resources. State and federal requirements to identify, assess, avoid, and/or mitigate impacts on cultural resources as part of NEPA and the NHPA, would limit the extent and scale of impacts on cultural resources.	Vineyard Wind's onshore cultural resource investigations determined that the Proposed Action would not impact any terrestrial cultural resources. Vineyard Wind has committed to conducting archaeological monitoring during construction in areas previously determined to have a moderate to high potential for undiscovered archaeological resources, including for the expanded the onshore substation. BOEM anticipates that if these investigations identify any significant cultural resources, Vineyard Wind would implement plans to avoid, minimize, and/or mitigate impacts aligned with Massachusetts state requirements and the NHPA requirements. As a result, and considering the possible presence of undiscovered resources, onshore construction of the Proposed Action would have localized, long-term, **minor** impacts on terrestrial cultural resources.	The impacts on cultural resources from this sub-IPF under the Proposed Action would primarily occur due to effects on undiscovered cultural resources, because the Proposed Action would not affect any known terrestrial cultural resources. As a result, the direct and indirect impacts of the Proposed Action under this sub-IPF would be localized, short-term, and **minor**. Ongoing activities and non-offshore wind activities would continue to impact terrestrial cultural resources through land disturbance. Future offshore wind development could impact known historic structures and TCPs, but would follow existing federal and state requirements to identify cultural resources, assess impacts, and implement measures to avoid, minimize, and/or mitigate impacts. As a result, cumulative impacts on cultural resources under this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be localized, long-term, and **minor**.
Climate change: Warming and sea level rise, storm severity/frequency	Sea level rise and increased storm severity and frequency would result in impacts on archaeological, historic structural, and TCP resources. Increased storm frequency and severity would also result in damage to and/or destruction of historic structures. Sea level rise would increase erosion-related impacts on archaeological and historic structural resources, while sea level rise would inundate archaeological, historic structural, and TCP resources.	Sea level rise and storm severity/frequency would increase due to the effects of climate change.	The effect of future offshore wind projects on slowing or arresting global warming and climate change (as causes of sea level rise, storm severity, and frequency; changes to habitats and ecology; changing migration patterns; damage to property and infrastructure; factors generating demand for coastal protective measures; and factors causing marine transgression/scouring) would result in limited to no impacts and could result in a beneficial impacts on cultural resources.	The direct and indirect contribution of the Proposed Action on slowing or arresting global warming and climate change (as causes of sea level rise, storm severity, and frequency; changes to habitats and ecology; changing migration patterns; damage to property and infrastructure; factors generating demand for coastal protective measures; and factors causing marine transgression/scouring) would result in **negligible** to **minor beneficial** impacts on cultural resources.	The Proposed Action would incrementally contribute to arresting global warming and associated sea level rise and increased storm severity/frequency, thus helping to avoid impacts on cultural resources, and resulting in long-term, widespread, **negligible** to **minor beneficial** impacts. Ongoing activities and non-offshore wind activities could contribute both beneficially (i.e., through onshore wind or solar energy projects) and adversely to climate change (i.e., through continued or increased emission of greenhouse gases). Other offshore wind activities would have similar effects as the Proposed Action, at a larger scale. As a result, the cumulative impacts on cultural resources associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be long-term, widespread, **negligible** to **minor**, and **beneficial**.
Climate change: Warming and sea level rise, altered habitat/ecology	Altered habitat/ecology related to warming seas and sea level rise would impact the ability of Native Americans and other communities to use maritime TCPs for traditional fishing, shell fishing, and fowling activities.	The rate of change to habitats/ecology would increase as a result of climate change.			
Climate change: Warming and sea level rise, altered migration patterns	Altered migration patterns related to warming seas and sea level rise would impact the ability of Native Americans and other communities to use maritime TCPs for traditional fishing, shell fishing, and fowling activities.	The rate of change to migratory animal patterns would increase as a result of climate change.			
Climate change: Warming and sea level rise, property/ infrastructure damage	Sea level rise and increased storm severity and frequency would result in impacts on archaeological, historic structural, and TCP resources. Increased storm frequency and severity would result in damage to and/or destruction of historic structures. Sea level rise would increase erosion-related impacts on archaeological and historic structural resources while sea level rise would inundate archaeological, historical structure, and TCP resources.	The rate of property and infrastructure damage would increase as a result of climate change.			
Climate change: Warming and sea level rise, protective measures (barriers, sea walls)	The installation of protective measures such as barriers and sea walls would impact archaeological resources during associated ground-disturbing activities. Construction of these modern protective structures would alter the viewsheds from historic properties and/or TCPs, resulting in impacts on the historic and/or cultural significance of resources.	The installation of coastal protective measures would increase as a result of climate change.			
Climate change: Warming and sea level rise, storm severity/frequency, sediment erosion, deposition	Sea level rise and increased storm severity and frequency would result in impacts on archaeological, historical structure, and TCP resources. Increased storm frequency and severity would result in damage to and/or destruction of historic structures. Sea level rise would increase erosion related impacts on archaeological and historic structure resources while sea level rise would inundate archaeological, historic structure, and TCP resources.	Sea level rise and storm severity/frequency would increase due to the effects of climate change.			

ADLS = Aircraft Detection Light System; BMP = best management practice; BOEM = Bureau of Ocean Energy Management; hazmat = hazardous materials; ESP = electrical service platform; IFP = impact-producing factors; km^2 = square kilometers; m^2 = square meters; MCT = New Bedford Marine Commerce Terminal; mg/L = milligrams per liter; MHC = Massachusetts Historical Commission; NEPA = National Environmental Policy Act; NHL = National Historic Landmark; NHPA = National Historic Preservation Act; NRHP = National Register of Historic Places; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor; OECR = Onshore Export Cable Route; RI and MA Lease Areas = Rhode Island and Massachusetts Lease Areas; SHPO = state historic preservation office; TCP = Traditional Cultural Property; WDA = Wind Development Area; WTG = wind turbine generator

Table 3.9-2: Summary of Historic Properties Cumulative Visual Impact Assessment

Historic Property	Maximum Number of WTGs Theoretically Visible	Average Number of WTGs Visible	Share of Resource Area with View of at least one WTG	Average Distance to Visible WTGs (miles)
Gay Head Lighthouse	585	200	76 percent	25.77
Chappaquiddick TCP	646	38	41 percent	27.81
Nantucket NHL	651	15	16 percent	28.68

NHL = National Historic Landmark; TCP = Traditional Cultural Property; WTG = wind turbine generator

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Table 3.10-1: Summary of Activities and the Associated Impact-Producing Factors for Recreation and Tourism

Baseline Conditions: Coastal New England has been extensively developed for water-based recreation and tourism. The scenic quality of the coastal environment is important to the identity, attraction, and economic health of many of the coastal communities. The visual qualities of historic coastal towns, which include marine activities within small-scale harbors, and the ability to view birds and marine life, are important community characteristics.

Recreational and tourist-oriented activities in the geographic analysis area are oriented towards the southern coast of Cape Cod and around Martha's Vineyard, Nantucket, and the nearby small islands. Water-oriented recreational activities include boating, visiting beaches, hiking, fishing, shellfishing, and bird and wildlife viewing. Boating covers a wide range of activities, from ocean-going vessels to small boats used by residents and tourists in sheltered waters, and includes sailing, sailboat races, fishing, shellfishing, kayaking, canoeing, and paddleboarding.

Commercial businesses offer boat rentals, private charter boats for fishing, whale watching and other wildlife viewing, and tours with canoes and kayaks. Many of the activities make use of coastal and ocean amenities that are free for public access. Nonetheless, these features function as key drivers for the coastal recreation and tourism sectors.

The highest density of recreational vessels routes occurs within 1 nautical mile of the coastline. Fishing is the most popular activity for recreational boaters.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Anchoring	Anchoring occurs due to ongoing military, survey, commercial, and recreational activities.	Impacts from anchoring would continue, and may increase due to offshore military operations, survey activities, commercial vessel traffic, and/or recreational vessel traffic. Modest growth in vessel traffic could increase the temporary, localized impacts of navigational hazards, increased turbidity levels, and potential for direct contact causing mortality of benthic resources.	Based on information from the Proposed Action, an offshore wind facility could generate an estimated average of 25 and a maximum of about 46 vessels present, per project, at any given time during construction, with variations based on the size and construction size of each project. Construction of 12 future offshore wind projects could occur within the RI and MA Lease Areas between 2021 and 2030, with a maximum of 4 projects under construction concurrently in 2022 and 2023. Occasional anchored vessels would be needed during operations. Anchored vessels would result in temporary, localized impacts as recreational boaters would need to navigate around anchored vessels. Temporary turbidity associated with anchoring could briefly alter the behavior of species important to recreational fishing and sightseeing.	Anchored vessels related to the Vineyard Wind 1 Project construction or decommissioning would result in temporary navigational hindrances and turbidity that would temporarily affect fish and invertebrates. Most vessel anchoring would be within safety zones for work areas. Peak construction periods could require an average of 25 and a maximum of 46 vessels within the WDA and OECC work areas. Anchoring would have direct and indirect, localized, short-term, **minor** impacts on tourism and recreation. Impacts would be **moderate** within Lewis Bay if the New Hampshire Avenue landfall site is selected.	Localized, temporary turbidity and navigational hindrances from anchoring during construction and decommissioning of the Proposed Action would have short-term, localized, **minor** to **moderate** impacts. Ongoing activities and future non-offshore wind activities would result in modest growth in vessel traffic with associated anchoring. Anchored vessels for construction and decommissioning of future offshore wind development other than the proposed Project would also have localized, temporary impacts on recreational boating within the RI and MA Lease Areas and along the offshore cable routes between 2021 and 2030. Cumulatively, as many as four projects including the Proposed Action could be under construction concurrently in 2022 and 2023, each requiring anchored vessels at offshore construction areas, with direct and indirect, localized, short-term, **minor** to **moderate** impacts on recreation and tourism.
Light: Vessels	Ocean vessels have an array of lights including navigational lights and deck lights.	Anticipated modest growth in vessel traffic would result in some growth in the nighttime traffic of vessels with lighting (Section 3.13.1).	Depending on scheduling for future offshore wind projects, construction vessels could be lit during nighttime transit or construction (i.e., from 2021 through 2030). Construction of 12 offshore wind projects could occur within the RI and MA Lease Areas between 2021 and 2030, with a maximum of 4 projects under construction concurrently in 2022 and 2023. Vessel lights could be visible from coastal locations depending upon vessel routes. Occasional nighttime vessel movements during operations would also require vessel lighting.	Nighttime lighting for vessels in transit and anchored within offshore work areas would occur when Project construction or maintenance takes place at night. Short-term vessel lighting is not anticipated to discourage recreational or tourist-related activities; lighting would have localized, short-term, intermittent, **negligible** impacts.	Nighttime lighting from construction of the Proposed Action would have localized, intermittent, short-term, **negligible** impacts on recreation and tourism. Nighttime vessel lighting from ongoing activities and future non-offshore wind activities would likely grow modestly. Future offshore wind development other than the proposed Project, if developed using nighttime construction, would result in intermittent increases in nighttime vessel lighting between 2021 and 2030; lighting would be short-term and localized. Cumulatively, vessel lighting would have short-term, **negligible** impacts on recreation and tourism.
Light: Structures	Offshore buoys and towers emit low-intensity light. Onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.	Up to 709 WTGs operated as part of the No Action Alternative would have aviation hazard and navigation lights, in accordance with the cumulative assumptions in Appendix A Table A-4, as well as USCG and FAA requirements, that would be visible from higher elevations and coastlines within the geographic analysis area depending on vegetation, topography, and atmospheric conditions (assuming the use of 12 or 14 MW WTGs). Views of lights on offshore wind energy structures would add a developed/industrial visual element to views that were previously characterized by dark, open ocean. This contrast could affect visitor decisions in selecting south-facing coastal and elevated locations to visit, but would be unlikely to affect recreation and tourism activities as a whole. ADLS, if implemented, could reduce the magnitude of these impacts.	Vineyard Wind has committed to voluntarily implementing ADLS as a self-imposed measure, which would activate WTG lighting less than 0.1 percent of annual nighttime hours. The lights on all of the Proposed Action's WTGs could potentially be visible from coastal and elevated locations on Martha's Vineyard, Nantucket, and neighboring islands (depending on vegetation, topography, weather, and atmospheric conditions). When visible, WTG lighting would add a developed/industrial visual element to views that were previously characterized by dark, open ocean. Due to the use of ADLS, the indirect impacts on recreation and tourism (from direct impacts on visual resources) would be long-term, continuous, and **negligible**.	Aviation hazard lighting on all of the Proposed Action's WTGs could possibly be visible from some coastal and elevated locations on Martha's Vineyard, Nantucket and neighboring islands, but only during ADLS activation, resulting in long-term, continuous, **negligible** impacts on recreation and tourism. Other than offshore wind, few offshore objects would have nighttime lighting. Onshore lighting from ongoing activities would be closer to onshore viewers (who would thus perceive onshore lighting as more intense). Onshore lighting would generally contribute the largest part of the cumulative impact of lighting on structures, except in cases where minimal onshore lighting is present. Future offshore wind development would result in aviation hazard lighting from 709 WTGs potentially visible from land within the geographic analysis area for recreation and tourism (assuming the use of 12 or 14 MW WTGs). The cumulative impacts of visible nighttime lighting on WTGs on recreation and tourism would be **minor**, due to the potential impacts of visitor preferences for locations without visible nighttime lighting. Use of ADLS, if used for offshore wind projects other than the Proposed Action, would reduce the visual impacts on recreation and tourism to **negligible**.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors. In the geographic analysis area for recreation and tourism, there are six existing power cables.	Cable maintenance or replacement of existing cables in the geographic analysis area would occur infrequently, and would generate short-term disturbances.	Cable emplacement and maintenance between 2021 and 2030 would result in vessel anchoring at offshore worksites, disturbances to the seafloor, and suspended sediment. Assuming similar installation procedures as the Proposed Action, the duration and range of impacts would be limited, and the disturbance to marine species important to recreational fishing and sightseeing would recover following the disturbance (Sections 3.4 and 3.5). Offshore wind export cables from the RI and MA Lease Areas could cross 1,310 miles (2,108 kilometers), while inter-array cables could total 1,480 miles (2,382 kilometers). The proportion or length of the export cables	Vineyard Wind cable emplacement would generate vessel anchoring and dredging at the worksite, requiring recreational vessels to avoid and navigate around the worksites and resulting in short-term disturbance to species important to recreation and tourism. The Proposed Action would require export cables that would cross approximately 98 miles (158 kilometers) and inter-array cables that would total about 177 miles (285 kilometers). The New Hampshire Avenue landfall would require an OECC route through Lewis Bay, one of the densest marine traffic areas in the study area for ferry and recreational vessels. Impacts on recreation	The Proposed Action's cable emplacement and maintenance would have localized, short-term, **minor** impacts on recreation and tourism, except that the New Hampshire Avenue landfall site would have **moderate** impacts due to the need for OECC installation within Lewis Bay. Installation at the landfall site and along the onshore cable route would have a short-term, direct, moderate impact on recreation and tourism. Ongoing maintenance and installation of offshore cables not related to offshore wind would generate short-term disturbances to recreational vessel routes and marine species. Future offshore wind development other than the proposed Project would require additional cable emplacement. Inter-array cable emplacement within the RI and MA Lease Areas would be within the geographic analysis area; the length and exact locations of export cables within the geographic analysis area would depend upon the detailed design of each offshore wind development, but some would be within the geographic analysis area. Cable emplacement

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			that would cross waters within the geographic analysis area is not known. Impacts of onshore cable installation would depend upon the specific location, but could temporarily disrupt beaches and other recreational coastal areas.	and tourism would be localized, short-term, and **minor**, except that the New Hampshire Avenue landfall site would have a localized, short-term, **moderate** impact due to the high volume of recreational marine traffic within Lewis Bay. Onshore cable installation would result in temporary road delays and disturbance of public beaches during landfall installation, with direct, short-term, **moderate** impacts on recreation and tourism.	would result in short-term, localized displacement of recreational boating. The cumulative impacts of cable emplacement on recreation and tourism would be direct and indirect, localized, short-term, and **minor** to **moderate** due to the need for recreational vessels to navigate around work areas, the potential disruption to public beaches and coastal recreation at landfall sites, and the temporary impacts on fish and invertebrates.
Noise: O&M	Limited to Block Island Wind Farm	Not applicable	Noise from up to 775 WTGs within the RI and MA Lease Areas could affect recreation and tourism directly from the nuisance effects of operational noise for recreational boaters close to WTGs. However, noise produced by WTGs is typically low and would be detectible only within a small area close to each WTG. No evidence suggests that such noise would affect marine mammals, finfish, invertebrates, and EFH (Sections 3.4.1 and 3.5.1). Noise from maintenance would be variable and short-term.	Noise from the 57 to 100 WTGs that would be installed for the Proposed Action could affect recreation and tourism directly from the nuisance effects of operational noise for recreational boaters. However, noise is anticipated to be of low intensity and detectible only within a small area close to each WTG. (Section 3.4; as measured at the Block Island Wind Farm, the low-frequency noise from WTG operation barely exceeds ambient levels at 164 feet [50 meters] from the WTG base.) Impacts on recreation and tourism would be long-term, continuous, and **negligible**.	The Proposed Action would result in operational noise near each WTG that would be audible only within a small area near the WTG, and is not anticipated to affect fish and marine mammals important to recreational activities. Impacts from Vineyard Wind's operational noise and periodic maintenance on recreation and tourism would be long-term, continuous, and **negligible**. Operation of ongoing and future non-offshore wind activities could result in additional offshore noise from vessel engines. Future offshore wind development would have up to 775 WTGs within the RI and MA Lease Areas, with each WTG creating noise audible within a small area close to the WTG. Cumulative operational and maintenance noise would be long-term and constant and would have **negligible** impacts on recreation and tourism.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.	An estimated 795 foundations (WTGs and ESPs) would be installed within the RI and MA Lease Areas between 2021 and 2030. Direct impacts on recreation and tourism would result from pile-driving noise intruding upon the natural sounds of the marine environment, although noise would be most intense within marine construction safety zones that are off limits to boaters. Indirect impacts would result from the effects of pile-driving noise on species important to recreational fishing and marine sightseeing activities (Sections 3.4.1 and 3.5.1). Pile driving is one of the most impactful noises on marine species, and impacts would be greater if multiple project construction activities occur in close spatial and temporal proximity. Overall impacts would be short-term, localized, and variable.	The Proposed Action would require installation of up to 102 foundations. Direct impacts on recreation and tourism would result from pile-driving noise intruding upon the natural sounds of the marine environment, although noise would be most intense within marine construction safety zones that are off limits to boaters. Indirect impacts would result from the effects of pile-driving noise on species important to recreational fishing and marine sightseeing activities (Sections 3.4.2 and 3.5.2). Impacts on recreation and tourism would be short-term and variable, and would include direct, **minor** impacts (as boaters avoid the areas of noise) as well as indirect, **minor** impacts.	Pile-driving noise from the Proposed Action construction would have localized, short-term, **minor** impacts due to the disturbance of the natural sounds of the marine environment and the impact on species important for recreational fishing or sightseeing, respectively. Ongoing and future non-offshore wind activities may result in occasional nearshore pile driving. Future offshore wind development would have similar contributions as the Proposed Action, requiring pile driving for installation of 795 foundations between 2021 and 2030. Cumulatively, the impact of pile driving on recreation and tourism would be localized, short-term, **minor** with respect to the direct impact on recreational boating, and **minor to moderate** with respect to the impact on marine mammals, finfish, and invertebrates, depending upon the impact on and length of time needed for recovery of marine species.
Noise: Cable laying/trenching	Offshore trenching occurs periodically in connection with cable installation or sand and gravel mining.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.	Direct impacts would result from trenching noise intruding on the natural sounds of the marine environment, with impacts experienced by recreational boaters primarily along OECC cable routes, which extend close to shorelines in areas heavily traveled by recreational boaters. Indirect impacts would result from effects on species important to recreational fishing and marine sightseeing activities (Sections 3.4.1 and 3.5.1). The length of OECC cable routes within the geographic analysis area cannot be determined without detailed project applications, but a total of about 1,310 miles of OECC cables would extend from the RI and MA Lease Areas to coastlines within or near the geographic analysis area.	Direct impacts would result from the noise of trenching intruding on the natural sounds of the marine environment, with impacts experienced by recreational boaters primarily along the 98 miles of OECC cable route, especially in nearshore areas heavily traveled by recreational boaters. Indirect impacts would result from effects on species important to recreational fishing and marine sightseeing activities (Sections 3.4.2 and 3.5.2). Impacts on recreation and tourism would be short-term, variable, and **minor**.	Trenching noise from the Proposed Action construction would have localized, short-term, variable, **minor** impacts on recreation and tourism due to the disturbance of the natural sounds of the marine environment and the temporary impacts anticipated on species important for recreational fishing or sightseeing. Ongoing and future, non-offshore wind activities would result in infrequent noise from trenching. Future offshore wind development would result in additional trenching for cable installation within the geographic analysis area from 2021 through 2030. Because the impacts of each trenching project are localized and short-term, cumulatively, the impact of noise from trenching on recreation and tourism would be **minor** (Sections 3.4.2 and 3.5.2).
Noise: Vessels	Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels (Section 3.13).	Planned new barge routes and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.	Assuming other offshore wind facilities generate vessel traffic similar to the projected Proposed Action vessel trips, construction of each offshore wind project would generate about 7 daily vessel trips during the entire construction period and about 18 daily vessel trips during peak construction periods. Up to 12 projects could be installed between 2021 and 2030, with a maximum of 4 projects under construction concurrently in 2022 and 2023. Each facility would generate about one to three vessel trips per day during its 30-year operational life. Vessel noise, especially during construction, may result in recreational vessels temporarily avoiding an affected area. Indirect impacts would result from avoidance of vessel noise by species important to recreational fishing and marine sightseeing activities (Sections 3.4.1 and 3.5.1). Vessel noise would be concentrated along routes between the ports (outside the recreation and tourism geographic analysis area) and the offshore wind work areas. Most vessel traffic would travel to the WTG and	The Proposed Action construction would generate an average of 7 daily vessel trips during the entire construction period and during peak construction periods would generate an average of 18 daily vessel trips. Proposed Action operations would generate 1 to 3 vessel trips from Vineyard Haven and New Bedford to the WDA. Vessel noise during construction may result in recreational vessels temporarily avoiding the highly trafficked water areas, as well as fish and marine mammals temporarily avoiding the areas of vessel noise (Sections 3.8.2 and 3.9.2). Impacts on noise from Proposed Action construction would have localized, short-term, **minor** impacts on recreation and tourism. Operational noise from vessel traffic would have long-term, continuous, **negligible** impacts.	The Proposed Action would result in increased vessel traffic and associated noise, resulting in localized, short-term, constant, **minor** impacts on recreation and tourism during construction, and localized, long-term, intermittent, **negligible** impacts during operations. Ongoing and future non-offshore wind activities would likely lead to increased vessel activity and associated noise. Future offshore wind projects would result in up to 12 offshore wind projects under construction between 2021 and 2030 with a maximum of 4 projects under construction concurrently in 2022 and 2023; each would generate vessel traffic similar to the Proposed Action, with variations depending on project size and construction schedules. Cumulatively, as many as 4 offshore wind projects could be under construction at one time, resulting in vessel noise impacts on recreation and tourism that would be localized, short-term, variable, and **minor** to **moderate** during construction, depending upon the temporal overlap of offshore wind project construction; and localized, long-term, intermittent, and **negligible** during operations.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			ESP installation areas, with fewer vessels needed along the cable installation routes.		
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The Marine Commerce Terminal at the Port of New Bedford was upgraded by the port specifically to support the construction of offshore wind energy facilities.	Ports would need to perform maintenance and upgrade facilities over the next 30 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.	Ports outside the geographic analysis area for recreation and tourism that are likely to be used for staging and construction, such as New Bedford, Brayton Point, ProvPort, and Davisville/Quonset Point, may provide facilities for recreational vessels, or may be on waterways shared with recreational marinas, and may experience increased activity and undergo expansion and dredging. The ports listed above, and other northeast ports suitable for staging and construction of the No Action Alternative projects are primarily industrial in character. Some provide for recreational vessels as a secondary use.	The Vineyard Wind 1 Project would use facilities at Vineyard Haven Harbor on Martha's Vineyard for the Operations and Maintenance Facility. Improvements at this facility would be completed to support the offshore wind industry as a whole, and not the Proposed Action specifically. Operation of the Proposed Action would generate 1 to 3 vessel trips per day, which would have localized, long-term, continuous, **negligible** impacts on recreation and tourism.	No expansion of Vineyard Haven Harbor is proposed in connection with the Proposed Action, although the Vineyard Wind 1 Project would use this facility during operations, resulting in a localized, long-term, continuous, **negligible** impact on recreation and tourism. Ongoing and future non-offshore wind activities would include ongoing maintenance for numerous harbors within the analysis area that are important for recreation and tourism. Future offshore wind projects would not contribute to this sub-IPF: all ports planned for offshore wind development and operation are outside the analysis area. Cumulatively, port usage in the analysis area (limited to Vineyard Haven) for Vineyard Wind 1 and other offshore wind projects would have a localized, long-term, continuous, **negligible**, impact on recreation and tourism.
Port utilization: Maintenance/ dredging	No major ports are within the geographic analysis area. Periodic maintenance is necessary for Vineyard Haven and numerous other harbors within the analysis area.	Ongoing maintenance and dredging of harbors on Martha's Vineyard, Nantucket, and Cape Cod will continue as needed. No specific projects are known.	Ports outside of the recreation and tourism geographic analysis area that are likely to be used for staging and construction, such as New Bedford, Brayton Point, ProvPort, and Davisville/Quonset Point, may provide facilities for recreational vessels, or may be on waterways shared with recreational marinas, and may experience increased activity and undergo expansion and dredging. The ports listed above, and other northeast ports suitable for staging and construction of the No Action Alternative projects are primarily industrial in character.	The Vineyard Wind 1 Project would not necessitate maintenance dredging at any port.	The Proposed Action would not require maintenance dredging at any port. Ongoing and future non-offshore wind activities would include ongoing maintenance for numerous harbors within the recreation and tourism geographic analysis area that are important for recreation and tourism. Future offshore wind projects would not contribute to this sub-IPF: no ports that would be used for offshore wind support are within the geographic analysis area. Because the Proposed Action would not contribute direct impacts, there would be no cumulative impacts on recreation and tourism from this sub-IPF.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. The likelihood of allisions is expected to continue at or near current levels.	Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.	Construction and operations of wind energy facilities would increase the number of structures in the water, therefore increasing the risk of allision (Section 3.13). Up to 977 structures (WTGs and ESPs, assuming use of 8 MW WTGs) could be built within the RI and MA Lease Areas. Generally, vessels more likely to allide with WTGs or ESPs would be smaller vessels such as recreational vessels. Risk of allision with anchored vessels would increase incrementally during construction (i.e., from 2021 through 2030) as more anchored vessels would be within the recreation and tourism geographic analysis area, but the risk would be small due to the safety zones around work areas.	Construction and operation of the Proposed Action would add up to 102 offshore wind structures in the water, thereby increasing the risk of allision (Section 3.13). Generally, vessels more likely to allide with WTGs or ESPs would be smaller vessels such as recreational vessels. 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, but the risk would be small due to the safety zones around work areas. The impact of the Vineyard Wind 1 Project on recreation and tourism due to the risk of allisions would be direct, long-term, continuous, and **minor**.	The impact of the Proposed Action on recreation and tourism due to the risk of allisions would be direct, long-term, continuous, and **minor**. Ongoing activities and future, non-offshore wind activities would not result in increased risk of allision. Future offshore wind development would result in a greater risk of allisions within the RI and MA Lease Areas, with a potential total of 977 offshore wind energy structures (assuming the use of 8 MW WTGs). Cumulatively, Vineyard Wind and other offshore wind projects would have a direct, long-term, continuous, **minor** to **moderate** impact on recreation and tourism due to the risk of allisions with offshore wind structures.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.	Development of offshore wind would result in additional WTGs, ESPs, scour protection, and hard cover protection for cables, increasing the risk of recreational fishing gear loss or damage due to entanglement. Offshore wind development within the RI and MA Lease Areas would result in an estimated 339 acres of export cable hard protection, 242 acres of inter-array cable hard protection, in addition to the scour protection around 977 offshore foundations (assuming the use of 8 MW WTGs). Impacts at any one location for recreational fishing would be intermittent, localized, and long-term.	Vineyard Wind would add up to 102 foundations with scour protection, as well as 35 acres of export cable hard protection and 63 acres of inter-array cable hard protection. This would increase the risk of gear loss/damage by entanglement. The impact of Vineyard Wind on recreation and tourism due to the risk of entanglement and gear loss would be direct, long-term, continuous, and **minor**.	The impact of the Proposed Action on recreation and tourism due to the risk of recreational fishing gear entanglement and loss would be direct, long-term, continuous, and **minor**. Ongoing activities would not increase in risk of gear loss or damage due to entanglement. Future offshore wind would result in the risk of gear entanglement and loss due to the scour protection and inter-array cable hard protection within each offshore wind project in the RI and MA Lease Areas, as well as additional cable hard cover protection for the export cables, which would include cables within the geographic analysis area that cannot be quantified without detailed plans for each offshore wind project. Cumulatively, Vineyard Wind and other offshore wind projects would have a direct, long-term, continuous, **minor** to **moderate** impacts on recreation and tourism due to the risk of entanglement and gear loss.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these locations. Recreational and commercial fishing can occur near these aggregation locations, although recreational fishing is more popular, because commercial mobile fishing gear is more likely to snag on structures.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	The potential for 977 offshore wind energy structures within the geographic analysis area (assuming the use of 8 MW WTGs) could encourage fish aggregation and/or generate reef effects that attract recreational fishing vessels. This attraction would likely be limited to the minority of recreational fishing vessels that already travel as far from shore as the wind energy facilities, but could potentially result in broad changes in recreational fishing practices if fish attraction and reef effects are widespread enough to encourage more participants to travel further from shore.	The Proposed Action could encourage fish aggregation and/or generate reef effects that attract recreational fishing vessels to up to 102 offshore structure foundations (WTGs and ESPs). This attraction would likely be limited to the minority of recreational fishing vessels that already travel as far from shore as the wind energy facilities. This would have long-term, **negligible beneficial** impacts on recreation and tourism.	The impacts on recreation and tourism from this sub-IPF under the Proposed Action would include limited increases in recreational fishing activity due to fish aggregation and reef effects that could occur at some of the Proposed Action's 102 offshore structures. This would have long-term, **negligible beneficial** impacts on recreation and tourism. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action; the 977 potential offshore structures (assuming the use of 8 MW WTGs) could produce changes in recreational fishing practices that would result in more recreational vessels traveling as far from shore as the offshore wind facilities. Cumulative impacts on recreation and tourism from this sub-IPF would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, thus long-term, **minor beneficial** impacts on recreation and tourism are expected.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Habitat conversion	Structures, including foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented species thus benefit on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	Offshore wind energy facilities could create foraging opportunities for seals and small odontocetes (toothed whales), and sea turtles, possibly attracting private or commercial recreational sightseeing vessels. As a result, the presence of new habitat could increase recreation and tourism activity associated with offshore sightseeing. New structures would be added intermittently between 2021 and 2030, and could benefit structure-oriented species as long as the structures remain.	Up to 102 foundations (WTGs and ESPs) installed as part of the Proposed Action could create foraging opportunities for seals, small odontocetes, and sea turtles, possibly attracting private or commercial recreational sightseeing vessels. The habitat created by these new structures could thus provide new opportunity for wildlife viewing from vessels fishing. Sightseeing vessels already operating from Nantucket Sound may be attracted to the WDA. The impact of the Proposed Action on recreation and tourism due to the potential for habitat creation would therefore be indirect, long-term, continuous, **minor beneficial**.	The impacts on recreation and tourism from this sub-IPF under the Proposed Action would include increased sightseeing vessel activity in the Proposed Action area if marine mammals are attracted to any reef-like habitats created by WTG and ESP foundations. This would have long-term, **minor beneficial** impacts on recreation and tourism. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but the addition of up to 977 offshore wind structures (assuming the use of 8 MW WTGs) between 2021 and 2030 could encourage a larger number of sightseeing vessels to travel to offshore wind facilities. Cumulative impacts on recreation and tourism from this sub-IPF would be similar to those described for the Proposed Action, but would occur across the RI/MA Lease Areas, resulting in long-term, continuous, **minor beneficial** impacts.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure and each other.	Vessel traffic, overall, is not expected to meaningfully increase over the next 30 years. The presence of navigation hazards is expected to continue at or near current levels.	Future offshore wind development would add up to 957 WTGs (assuming the use of 8 MW WTGs) and 20 ESPs within the geographic analysis area for recreation and tourism, thereby increasing navigation hazards for recreational boaters. The need to navigate around these structures may present risk to recreational boaters and may discourage some offshore recreation and tourism, resulting in long-term, continuous, regional (throughout the RI and MA Lease Areas) impacts on recreation and tourism.	Up to 102 structures (WTGs and ESPs) installed as part of the Proposed Action would increase navigation hazards for recreational boaters. The perceived risk of incidents such as allisions and collisions could discourage recreational boaters from traveling to and through the WDA, resulting in selection of other routes. The impact of Vineyard Wind on recreation and tourism due to navigational hazards within the WDA would be direct, long-term, continuous, and **minor**.	The impact of the Proposed Action on recreation and tourism due to navigational hazards within the WDA, specifically from WTGs and ESPs, would be direct, long-term, continuous, and **minor**. Navigation hazards from ongoing and future non-offshore wind activities would continue to exist, but would not meaningfully increase. Future offshore wind development other than the proposed Project would result in greater navigational hazards from the long-term presence of up to 977 total WTGs and ESPs (assuming the use of 8 MW WTGs). Cumulatively, Vineyard Wind and other offshore wind projects would have a direct, long-term, continuous, **minor** to **moderate** impact on recreation and tourism due to navigation hazards within wind development areas.
Presence of structures: Space use conflicts	Current structures do not result in space use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	Offshore wind energy structures within up to 12 offshore wind projects in the RI and MA Lease Areas could affect established offshore recreation and tourism activities, including fishing, sailboat races, tour boat routes, and other recreational boating, during construction and operations of the No Action Alternative projects. The structures would require vessels to travel in channels between structures, would hinder passage of large sailboats (depending on mast height and turbine blade clearance), and would occupy areas that might have been used for recreational fishing. The affected area would increase as additional wind energy facilities begin the construction phase.	The constraints on navigation resulting from up to 102 offshore wind structures would require vessels to travel in the channels between structures, increasing the possibility of conflicts or collisions between vessels. WTGs would occupy current locations favored for recreational fishing. The WTG blades would hinder large sailboats (with mast height of 89 feet or greater) from traveling near the WTGs. The impact of Vineyard Wind on recreation and tourism due to space use conflicts within the WDA would be direct, long-term, continuous, and **minor**.	The impact of the Proposed Action on recreation and tourism due to space use conflicts within the WDA, such as vessels being restricted to channels between WTGs and ESPs, would result in potential conflicts. These impacts would be direct, long-term, continuous, and **minor**. Ongoing activities and planned, non-offshore wind activities would not add offshore structures. Future offshore wind development other than the proposed Project would result in similar navigational constraints, with displacement or channelization of recreational fishing and boating within 12 offshore wind projects in the RI and MA Lease Areas. Cumulatively, Vineyard Wind and other offshore wind projects would have a direct, long-term, continuous, **minor** to **moderate** impact on recreation and tourism due to space use conflicts within multiple wind development areas.
Presence of structures: Viewshed	The only existing offshore structures within the viewshed of the Vineyard Wind are minor features such as buoys.	Non-offshore wind structures that could be viewed in conjunction with the offshore components of the Vineyard Wind 1 Project would be limited to meteorological towers. Marine activity would also occur within the marine viewshed.	Under the No Action Alternative, portions of all 775 WTGs associated with the No Action Alternative (assuming the use of 12 or 14 MW WTGs) would potentially be visible from south-facing shorelines and some elevated areas on Martha's Vineyard, Nantucket, and possibly mainland Cape Cod, depending on vegetation, topography, and atmospheric conditions. The presence of visible WTGs would add a developed/ industrial visual element to ocean views that were previously characterized by open ocean. These impacts on visual resources could influence the decisions of visitors to coastal and elevated locations with south-facing views, especially in locations that do not receive heavy tourist use (i.e., where limited human activity is an expected visual condition), thus affecting recreation and tourism activity, although this effect diminishes with the distance between observers and WTGs. More than 95 percent of WTGs would be more than 15 miles (24 kilometers) from shore, limiting the impact of the No Action Alternative on recreation and tourism in the overall analysis area.	Under the maximum impact scenario for the Proposed Action, portions of all 57 of the Proposed Action's 14 MW WTGs could potentially be visible from south-facing shorelines and some elevated areas on Martha's Vineyard, Nantucket, and possibly mainland Cape Cod, depending on vegetation, topography, and atmospheric conditions. Visible WTGs would add a developed/industrial visual element to ocean views that were previously characterized by open ocean. These impacts on visual resources could influence the decisions of visitors to coastal and elevated locations with south-facing views, thus affecting recreation and tourism activity. This effect would be more likely to occur in locations that do not receive heavy tourist use (i.e., where limited human activity is an expected visual condition), and diminishes with the distance between observers and WTGs, and would be more likely to occur. Due to the distance from the closest WTGs (nearly 15 miles), the impact of the Proposed Action on recreation and tourism due to visibility of WTGs would be direct, long-term, continuous, and **minor**.	The impact of the Proposed Action on recreation and tourism due to the visual impact of WTGs would be direct, long-term, continuous, and **minor**. Other ongoing and non-offshore wind activity would not contribute to this sub-IPF. Future offshore wind development would result in portions of all 775 WTGs associated with the No Action Alternative (assuming the use of 12 or 14 MW WTGs) potentially visible from coastal locations in the geographic analysis area for recreation and tourism, and more than one project may be visible at a time from some locations. Cumulatively, visible WTGs would add a developed/industrial visual element to ocean views that were previously characterized by open ocean, especially in locations that do not receive heavy tourist use (i.e., where limited human activity is an expected visual condition) These impacts on visual resources could influence the decisions of visitors to coastal and elevated locations with south-facing views, thus affecting recreation and tourism activity, although this effect diminishes with the distance between observers and WTGs. Accordingly, the Proposed Action and other offshore wind projects would have a direct, long-term, continuous, **minor** impacts on recreation and tourism in the overall geographic analysis area, with **moderate** impacts on south-facing shoreline areas of Martha's Vineyard, Nantucket, and Cape Cod with views of WTGs.
Traffic: Vessels	Study area ports and marine traffic related to shipping, fishing, and recreation are important to the region's economy. No substantial changes are anticipated to existing vessel traffic volumes (Section 3.13).	New vessel traffic near the study area would be generated by proposed barge routes and dredging demolition sites over the next 30 years. Marine commerce and related industries would continue to be important to the study area economy.	Up to 12 offshore wind projects may be constructed in the RI and MA Lease Areas between 2021 and 2030. Assuming other offshore wind facilities generate vessel traffic similar to the projected Proposed Action vessel trips, construction of each offshore wind project would generate about 7 daily vessel trips during the entire construction period and about 18 daily vessel trips during peak construction periods. Each facility would generate about one to three vessel trips per day during its 30-year operational life. Increased vessel traffic may result in localized inconvenience, minor delays, and navigational complexity for recreational vessel traffic. Impacts would	The Proposed Action construction would generate an average of 7 daily vessel trips during the entire construction period and during peak construction periods would generate an average of 18 daily vessel trips. Selection of the New Hampshire Avenue cable landfall site and OECC route would generate vessel trips in Lewis Bay, an area heavily traveled by recreational vessels. Operation would generate about 1 to 3 trips daily to the WDA from either Vineyard Haven or the Port of New Bedford (outside the recreation and tourism geographic analysis area). Impacts of construction-related vessel traffic on recreation and	Increased vessel traffic from the Proposed Action would have a localized, short-term, variable, **minor** impact on recreation and tourism during construction, except for a **moderate** impact within Lewis Bay if the New Hampshire Avenue landfall site and OECC route is selected. Impacts of vessel traffic during operations would be localized, long-term, intermittent, and **negligible**. Ongoing and future, non-offshore wind activities would continue to result in substantial vessel traffic within the recreation and tourism geographic analysis area, with potential for modestly increasing volume. Offshore wind development other than the proposed Project would result in up to 12 potential future offshore wind projects within the geographic analysis area, each with vessel traffic similar to the Proposed Action, and the largest impacts would occur when as many as 4 projects are under construction concurrently. Vessel traffic from the Proposed Action, in combination with the No Action Alternative, would have a short-term, continuous, **minor** to **moderate**

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			be greater during construction of multiple wind energy facilities (including 2022 to 2023, when up to four projects would be simultaneously under construction). Overall, impacts would be short-term, continuous, and localized.	tourism would be direct, localized, short-term, variable, and **minor**, except that the impact of vessel traffic within Lewis Bay would be **moderate** if the New Hampshire Avenue landfall site and OECC route is selected. Impacts of vessel traffic during operations would be localized, long-term, intermittent, and **negligible**.	impact on recreation and tourism during construction, and a localized, long-term, intermittent, **negligible** impact during operations.
Traffic: Vessel collisions	The region's substantial marine traffic may result in occasional vessel collisions, which would result in costs to the vessels involved. The likelihood of collisions is expected to continue at or near current rates.	An increased risk of collisions is not anticipated from future activities.	Increased vessel traffic during offshore wind development (i.e. from 2021 through 2030), and to a lesser extent during offshore wind operations, would marginally increase the risk of collision. Impacts would be greater during simultaneous construction of up to four wind energy facilities in 2022 and 2023. Impacts of construction-related vessel collision risk on recreation and tourism would be direct, long-term, and variable.	Increased vessel traffic during construction, and to a lesser extent during operations, could result in a proportional increase in the risk of vessel collisions. Impacts of construction-related vessel collision risk on recreation and tourism would be direct, long-term, variable, and **minor**, except for **moderate** impacts within Lewis Bay if the New Hampshire Avenue landfall site and OECC route is selected, due to the high volume of recreational vessel traffic near the OECC within Lewis Bay. Impacts of vessel collision risk during operations would be localized, long-term, intermittent, and **negligible**.	The Proposed Action would result in an increased construction-related vessel collision risk, with an impact on recreation and tourism that would be direct, long-term, variable, and **minor**, except for **moderate** impacts in Lewis Bay if the New Hampshire Avenue landfall site is selected. Impacts of vessel collision risk during operations would be localized, long-term, intermittent, and **negligible**. Ongoing and future, non-offshore wind activities would continue to result in substantial vessel traffic within the geographic analysis area, with potential for vessel collisions. Future development (other than the proposed Project) of up to 12 offshore wind projects would result in vessel traffic during the 2021 and 2030 construction period (including up to 4 projects under construction simultaneously), resulting in increased risk of collision for recreational vessels sharing the waters near the offshore transit and work areas. The increased risk of vessel collision resulting from the Proposed Action, in combination with the No Action Alternative, would have a long-term, variable, **minor** impact on recreation and tourism during construction, and a localized, long-term, intermittent, **negligible** impact on recreation and tourism during operations.

ADLS = Aircraft Detection Light System; EFH = essential fish habitat; ESP = electrical service platform; FAA = Federal Aviation Administration; IPF = impact-producing factors; MW = megawatts; OECC = Offshore Export Cable Corridor; RI and MA = Rhode Island and Massachusetts; SEIS = Supplemental EIS; USCG = U.S. Coast Guard; WDA = Wind Development Area; WTG = wind turbine generator

Table 3.11-1: Summary of Activities and the Associated Impact-Producing Factors for Commercial Fisheries and For-Hire Recreational Fishing

Baseline Conditions: The fisheries resources in federal waters off New England provide a significant amount of revenue. New Bedford, Massachusetts, has consistently been the highest value-producing U.S. fishing port (NOAA 2018b). In 2018, commercial fisheries harvested more than 1.2 billion pounds of fish and shellfish in the North and Mid-Atlantic region, for a total landed value of over $1.8 billion; from 2009 to 2018, average annual landings were 1.3 billion pounds with a value of $1.6 billion (ACCSP 2018). From 2009 to 2018, the value of landings has ranged from $1.2 billion to over $1.8 billion, while landings weight has ranged from 1.16 billion pounds to 1.40 billion pounds. In Massachusetts, commercial fisheries harvested over 222 million pounds of fish and shellfish in 2018 for a total landed value of over $630 million.

Regional commercial fisheries are known for the large landings of herring, menhaden, clam, squid, scallop, skates, and lobster, and for being a notable source of profit from scallop, lobster, clam, squid, and other species (NOAA 2019a). Commercial fisheries obtained the greatest concentration of revenue from around the 164-foot (50-meter) contour off Long Island and George's Bank. Over 4,300 federally permitted fishing vessels were in the Northeast in 2017 landing fish in several major northeast ports (Table 3.11-2).

For-hire recreational fishing is also an important economic sector regionally with peak activity from June through August (NOAA 2017b). Regionally in 2015, the industry created 2,232 jobs, generated $326 million in sales, and contributed $192 million in value added. The Marine Recreational Information Program data show that mackerels, cod, and striped bass were the most-caught species within the Massachusetts for-hire recreational fishery. Black sea bass, scup, striped bass, summer flounder, and tautog were the most-caught species within the Rhode Island for-hire recreational fishery (NOAA 2017a). For-hire recreational fishing in the Atlantic provides opportunities for recreational fishing of highly migratory species such as tuna, billfish, swordfish, and sharks. Tuna and sharks are targeted in the WDA by for-hire fishing boats. See Draft EIS Section 3.4.5.1, Description of the Affected Environment for Commercial Fisheries and For-Hire Recreational Fishing, for additional discussion on the commercial and for-hire recreational fisheries, including fishing ports and state-regulated fisheries, within the region surrounding the RI and MA Lease Areas. See Draft EIS Section 3.4.1, Demographics, Employment, and Economics, for additional discussion on port communities.

Commercial fisheries and for-hire recreational fishing in the geographic analysis area for this resource are subject to pressure from ongoing activities, including regulated fishing effort, vessel traffic, and climate change. NMFS partners with regional fishery management councils and the Atlantic States Marine Fisheries Commission to predict the abundance of fish stocks, set catch limits, and promulgate and ensure adherence to regulations. Fisheries management affects commercial fisheries and for-hire recreational fishing in the region through management of sustainable fish stocks and measures to reduce impacts to important habitat and protected species. These management plans include measures such as fishing seasons, quotas, and closed areas that constrain how the fisheries are able to operate and adapt to change. Management actions can reduce or increase the size of available landings to commercial and for-hire recreational fisheries. Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the North Atlantic right whale by 60 percent (McCreary and Brooks 2019). This, along with Area 3 trap cap reductions, will likely have a significant impact on fishing effort in the lobster and Jonah crab fisheries in the geographic analysis area for this resource. Most fisheries will continue to implement adjustments to fishery-specific annual catch limits (both increases and decreases) and measures to prevent exceeding such limits. This will affect fishery operations in different ways that are very difficult to anticipate for the purposes of assessing cumulative impacts of the Proposed Action, future offshore wind activities, ongoing activities, and future non-offshore wind activities.

The Omnibus Deep Sea Coral Amendment's closures in the Gulf of Maine are expected to displace some bottom tending mobile gear effort locally, but not likely in areas affected by the Proposed Action. A future action that would reopen the Cape Hatteras Gear Restricted Area and the Northeastern United States Closed Area to pelagic longline vessels targeting highly migratory species may result in seasonal shifts in fishing effort into those areas from other fishing locations and change vessel transit patterns, including from the Massachusetts, New Jersey, and New York ports. The New England Fishery Management Council's Habitat Clam Dredge Exemption Framework Action allows surfclam vessels to fish in parts of the Great South Channel Habitat Management Area and may move such effort out of lease areas, while proposed lobster trap reductions in Areas 2 and 3 may also slightly decrease effort within the offshore wind areas. Finally, Amendment 8 to the Atlantic Herring FMP implements a ban on using midwater trawl gear inshore of 12 nautical miles from Canada to the Rhode Island/Connecticut border and inshore of 20 nautical miles off Cape Cod; this is expected to either displace herring midwater trawl fishing effort or result in vessels switching to bottom trawl or purse seine gear. If herring midwater trawl vessels switch to using bottom trawl gear, herring fishing effort may continue inshore of the area affected by the Proposed Action. If midwater trawl vessels do not switch to bottom trawl gear, their effort may be displaced offshore into other offshore wind areas (Douglas Christal, Pers. Comm., March 20, 2020).

Additionally, there is substantial variability in the volume and value landed of various species fished within the WDA. Year-to-year variation in available catch, fishing effort as well as quotas set for commercial and recreational fisheries to protect stocks and prevent overfishing, introduce significant fluctuations in how much is landed every year from within the WDA, the Massachusetts Lease Area, and other locations. In the New England and Mid-Atlantic regions, as of December 2019, 12 fish stocks are in an overfished condition, and 5 are currently subject to overfishing and are in an overfished condition (NOAA 2019b). See Table 3.4-1 for details on impacts on fish.

In addition to regulated fishing effort, commercial fisheries and for-hire recreational fishing are subject to impacts from climate change. Climate change is also predicted to affect Northeast fishery species (Hare et al. 2016), which will affect commercial and for-hire fisheries differently depending on the targeted species. Changing environmental and ocean conditions (currents, water temperature, etc.), increased storm magnitude or frequency, and shoreline changes can affect fish distribution, populations, and availability to commercial and recreational for-hire fisheries. See Table 3.4-1 for details on impacts on fish.

Vessel traffic would also affect commercial fisheries and for-hire recreational fishing, including traffic congestion, delays at ports, and difficulties with navigation. Currently there are few structures in offshore waters, so there are very few impediments to transiting and fishing. There are also no artificial impediments to movement of currents/waves/wind that might affect the offshore marine (pelagic and benthic) ecosystem. Impacts from other ongoing activities, including structures such as existing cables and pipelines, have been largely mitigated through burial of the infrastructure.

The following sources provide quantitative details in support of the level of impact associated with the IPFs shown in this Table 3.11-1:

- From Table 3.11-3: Average Annual Percentage of Total Mid-Atlantic and New England Fishery Revenue Exposed to Offshore Wind Energy Development by FMP (2020-2030), Table 3.11-4: Average Annual Revenue from all Lease Areas for Exposed Port Groups, 2013-2018, Figure 3.11-1: All VMS Fisheries in RI and MA Lease Areas—Fishing, Figure 3.11-2: All VMS Fisheries in RI and MA Lease Areas—Transiting, Figure 3.11-3: All VMS Fisheries in the WDA—Fishing and Transiting, Figure 3.11-4: All VMS Fisheries in the WDA—Fishing, Figure 3.11-5: Sea Scallop Fishery in RI and MA Lease Areas—Transiting, and Figure 3.11-6: Squid, Mackerel, Butterfish Fishery in RI and MA Lease Areas—Fishing.
- From the DEIS Table 3.4.5-8: Average Annual For-Hire Recreational Trips within 1 Mile of MA WEA, 2007–2012.
- Kirkpatrick et al. 2017. (Socio-Economic Impact of Outer Continental Shelf Wind Energy Development on Fisheries in the U.S. Atlantic.)

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Anchoring	Impacts from anchoring occur due to ongoing military, survey, commercial, and recreational activities. The short-term, localized impact to this resource is the presence of a navigational hazard (anchored vessel) to fishing vessels.	Impacts from anchoring may occur on a semi-regular basis over the next 30 years due to offshore military operations, survey activities, commercial vessel traffic, and/or recreational vessel traffic. Anchoring could pose a temporary (hours to days), localized (within a few hundred meters of anchored vessel) navigational hazard to fishing vessels.	The cumulative scenario would result in increased anchoring during construction over the next 10 years, and intermittently during operation of offshore components and survey activities. Anchoring could temporarily (hours to days) disrupt fishing activities within a few hundred meters of the anchored vessel. All impacts would be localized, occurring primarily during construction, but also during operations and decommissioning. The location and level of these temporary, localized impacts would depend on specific locations and activity duration. See the Presence of structures: Navigation hazard sub-IPF.	Anchored vessels could pose a navigational hazard to fishing vessels and temporarily (hours to days) disrupt fishing activities within a few hundred meters of the anchored vessel. The location and level of these temporary, localized impacts would depend on specific locations and activity duration. This IPF is expected to have localized, short-term, **minor** impacts on commercial fisheries and for-hire recreational fishing, occurring primarily during construction, but also intermittently during operations and decommissioning.	Anchoring for the Proposed Action would result in localized, short-term, **minor** impacts on commercial fisheries and for-hire recreational fishing and would likely not be distinguishable from ongoing activities. Ongoing and future non-offshore wind activities would cause short-term, local impacts. Offshore wind activities, other than the proposed Project, would have similar temporary, local impacts on fishing vessels. Cumulatively, increased anchoring would result in localized, short-term, **minor** impacts on commercial fisheries and for-hire recreational fishing, including navigational hazards to fishing vessels, especially if projects are overlapping in the same area as fishing or transiting fishing vessels.
New cable emplacement/ maintenance	New cable emplacement and infrequent cable maintenance activities disturb the seafloor, increase suspended sediment, and cause temporary displacement of fishing vessels. These disturbances would be local and limited to the emplacement corridor. In the geographic analysis area for this resource, there are six existing power cables (BOEM 2019b).	Future new cables and cable maintenance, perhaps connecting Martha's Vineyard and/or Nantucket to the mainland, would occasionally disturb the seafloor and cause temporary displacement in fishing vessels and increases in suspended sediment resulting in local, short-term impacts. The FCC has two pending submarine tele-communication cable applications in the North Atlantic. If the cable routes enter the geographic analysis area for this resource, short-term disruption of fishing activities would be expected.	Jet plowing/dredging during construction, installation, and maintenance activities could disrupt fishing activity. The total area of direct seafloor disturbance is estimated at up to 8,153 acres (33.0 km^2). Fishing vessels may need to temporarily relocate from these areas to other fishing locations to continue to earn revenue, which could lead to increased conflict in those locations, increased operating costs for vessels (e.g., additional fuel costs), and reduced revenue (e.g., less productive area; less valuable species). Additionally, increased suspended sediment would have temporary impacts on species important to commercial and for-hire fisheries (Table 3.4-1 discusses impacts on finfish and invertebrates.	The Proposed Action would cause short-term disturbances during construction and possibly during maintenance. The Proposed Action estimated that up to 328 acres (1.3 km^2) of sea floor could be disturbed by cable installation and that up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation, potentially leading to short-term impacts including displacement of fishing vessels from these areas. During the construction and installation activities, it may not be possible to fish in parts of the WDA, which may result in reduced revenue and/or increased conflict over other fishing grounds. For fishing vessels operating within the WDA, the greatest impacts would be during foundation and cable installation. Large areas would not be restricted for long periods; however, temporary limitations to fishing activities could occur. This would have localized, short-term, **minor** impacts on commercial fisheries and for-hire recreational fishing. Additionally, increased suspended sediment could have temporary impacts on species important to commercial and for-hire fisheries Table 3.4-1discusses impacts on finfish and invertebrates.	The Proposed Action estimated that up to 328 acres (1.3 km^2) of sea floor could be disturbed by cable installation and that up to 69 acres (0.3 km^2) could be affected by dredging prior to cable installation, leading to localized, short-term, **minor** impacts on commercial fisheries and for-hire recreational fishing, including temporary displacement of fishing vessels from these areas during construction and maintenance. Ongoing and future non-offshore wind activities, if any involve this IPF, may cause local short-term impacts on fishing activities. Future offshore wind activities other than the proposed Project could lead to temporary fishing vessel displacement from these areas. Cumulatively, localized, short-term, **minor** impacts fishing vessel displacement) would occur as a result of an estimated 8,156 acres (33.0 km^2) of disturbance and temporary avoidance for fishing vessels.
Noise: Construction, trenching, operations and maintenance	Noise from construction occurs frequently in coastal habitats in populated areas in New England and the Mid-Atlantic, but infrequently offshore. The intensity and extent of noise from construction is difficult to generalize, but impacts are local and temporary. Infrequent offshore trenching could occur in connection with cable installation. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Low levels of elevated noise from operational WTGs likely have low to no impacts on fish and no impacts at a fishery level Table 3.4-1discusses impacts on finfish and invertebrates. Noise is also created by operations and maintenance of marine minerals extraction, which has small, local impacts on fish, but likely no impacts at a fishery level.	Noise from construction near shore is expected to gradually increase in line with human population growth along the coast of the geographic analysis area for this resource. Noise from dredging and sand and gravel mining could occur. New or expanded marine minerals extraction may increase noise during their operations and maintenance over the next 30 years. Impacts from construction, operations, and maintenance would likely be small and local on fish, and not seen at a fishery level. Periodic trenching would be needed for repair or new installation of underground infrastructure. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise on commercial fish species are typically less prominent than the impacts of the physical disturbance and sediment suspension. Therefore, fishery-level impacts are unlikely Table 3.4-1 discusses impacts on finfish and invertebrates.	In the expanded cumulative scenario, construction of 2,066 offshore structures would create noise and temporary impacts on commercial fisheries and for-hire recreational fishing. The greatest impact of noise is likely to be caused by pile driving (see below). Such noise would be intermittent and would occur over an assumed 6- to 10-year period. Noise from trenching of inter-array and export cables would be temporary, local, and extend only a short distance beyond the emplacement corridor. While noise from trenching could have temporary, local impacts on fish, fishery-level impacts are unlikely. 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, fishery-level impacts are unlikely Table 3.4-1 discusses impacts on finfish and invertebrates.	Construction of up to 102 offshore structures would create noise and temporary impacts on commercial fisheries and for-hire recreational fishing. The greatest impact of noise is likely to be caused by pile driving (see below). Noise from trenching of inter-array and export cables would occur during construction. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension. Noise from construction, trenching could have temporary, local impacts on commercial fish species, and fishery-level impacts would be **negligible.** 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, fishery-level impacts are unlikely Table 3.4-1discusses impacts on finfish and invertebrates.	The majority of impacts from construction noise are likely to be related to pile driving (see below). All other sources of construction noise, including trenching, and operations and maintenance noise would likely not lead to noticeable impacts on commercial fisheries and for-hire recreational fishing.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Noise: G&G	Ongoing site characterization surveys and scientific surveys produce noise around sites of investigation. These activities can disturb fish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes. The extent depends on equipment used, noise levels, and local acoustic conditions.	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 30 years. Seismic surveys used in oil and gas exploration create high-intensity impulsive noise to penetrate deep into the seabed, potentially resulting in injury or mortality to finfish and invertebrates in a small area around each sound source and short-term stress and behavioral changes to individuals over a greater area. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves more similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize, but are likely local and temporary.	Site characterization surveys for offshore wind facilities would create intermittent noise around sites of investigation over a 2- to 10-year period. This noise is expected to result in behavioral changes to commercial fish species in the immediate vicinity that could affect the catch efficiency of some gears (hook and line); however, the noise is not anticipated to affect reproduction and recruitment of commercial fish stocks into the fishery. Noise impacts from surveys could have temporary, local impacts during the short-term survey period.	Noise from G&G surveys during inspection and/or monitoring of cable routes may occur during construction and operations. G&G noise resulting from cable route surveys can disturb finfish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes; however, the noise is not anticipated to affect reproduction and recruitment of commercial fish stocks into the fishery. Noise impacts from surveys could have temporary, local impacts during the short-term survey period. Impacts on commercial fisheries and for-hire recreational fishing are anticipated to be temporary and **negligible**.	G&G survey noise from the Proposed Action may result in temporary **negligible** impacts on commercial fisheries and for-hire recreational fishing. Ongoing and future non-offshore wind impacts may result in similar types of impacts as the Proposed Action over an unknown extent. Future offshore wind other than the proposed Project would likely affect a much greater area than the Proposed Action would, and could lead to temporary impacts on fishing activities in the survey areas. Cumulative impacts would likely be approximately equal to the sum of all these impacts and would likely qualify as **negligible** to **minor**.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when ports or marinas, piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to finfish and invertebrates in a small area around each pile, and can cause short-term stress and behavioral changes to individuals over a greater area, leading to temporary local impacts on commercial fisheries and for-hire recreational fishing. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the analysis area other than ongoing activities.	Noise from pile driving would occur during installation of foundations for offshore structures for 4 to 6 hours at a time over a 6- to 10-year period and could have temporary impacts on commercial fish behavior. Sound impacts over a longer period may cause change in stock locations (i.e., fish would avoid areas with an abundance of noise or may not bite at hooks). Section 3.4.1 discusses impacts on fish. The behavioral response would vary by species and could result in changed availability to a fishery. Depending on the duration of pile driving coinciding with fishing activities, fishing vessels may need to temporarily relocate to other fishing locations to avoid or reduce impacts to revenue. This could lead to increased conflict in those locations, increased operating costs for vessels (e.g., additional fuel costs), and lower revenue (e.g., less productive area, less valuable species). Based on estimates from the COP, if all 2,066 foundations in the expanded cumulative scenario are summed, the risk of injury or mortality is expected to occur over approximately 12,127 acres (49.0 km^2). Noise impacts from pile driving could have temporary, local impacts on fishing activities during the construction period.	Noise from pile driving would occur during installation of foundations for 4 to 6 hours at a time and could cause injury and/or mortality to finfish and invertebrates in a small area around each pile and cause short-term stress and behavioral changes to individuals over a greater area. Sound impacts over a longer period may cause change in stock locations (i.e., fish would avoid areas with an abundance of noise or may not bite at hooks). Section 3.4.1 discusses the impacts on fish. The behavioral response would vary by species and could result in changed availability to a fishery. The estimated extent of behavioral effects is likely less than 5.7 miles (8 kilometers) around each pile, and the radius for injury or mortality is estimated to extend 285 feet (87 meters) from each foundation, totaling approximately 503 acres (2 km^2). Finfish and invertebrate eggs, embryos, and larvae could also experience developmental abnormalities or mortality resulting from this noise, although thresholds of exposure have not been defined as they have been for adult finfish (Weilgart 2018, Hawkins and Popper 2017). Depending on the duration of pile driving coinciding with fishing activities, fishing vessels may need to temporarily relocate to other fishing locations to avoid or reduce impacts to revenue. This could lead to increased conflict in those locations, increased operating costs for vessels (e.g., additional fuel costs), and lower revenue (e.g., less productive area, less valuable species). Noise impacts from pile driving could have temporary, local **minor** impacts on commercial fisheries and for-hire recreational fishing during the construction period.	The Proposed Action is expected to cause short-term impacts, with potential injury or mortality occurring across approximately 503 acres (2 km^2) of sea surface and behavioral changes occurring over a greater area. Depending on the duration of pile driving coinciding with fishing activities, there could be temporary **minor** impacts on commercial fisheries and for-hire recreational fishing. Future offshore wind activities other than the proposed Project could cause potential injury or mortality across approximately 12,127 acres (49.0 km^2) and behavioral changes over a greater area. The geographic analysis area affected by pile-driving noise would be the same regardless of whether the Proposed Action COP is approved, approved with modifications, or disapproved, and impacts could include potential injury or mortality across approximately 12,127 acres (49.0 km^2) and behavioral changes over a greater area. These direct impacts on commercial fish could affect fishing activities if vessels need to temporarily relocate to other fishing locations to avoid or reduce impacts to revenue. Depending on the timing and overlap of disturbance areas, the cumulative impact of pile driving on commercial fisheries and for-hire recreational fishing would likely qualify as **minor** to **moderate**.
Noise: Vessels	Vessel noise is anticipated to continue at levels similar to current levels. While vessel noise may have some impact on behavior, it is likely limited to brief startle and temporary stress responses. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels (Section 3.13.12).	Planned new barge route and dredging disposal sites would generate vessel noise when implemented (Section 3.13.1).	Future offshore wind activities would increase vessel noise primarily during construction but also during operations and decommissioning. While vessel noise could have temporary, local impacts on fish, fishery-level impacts are unlikely. Section 3.4.11 discusses impacts on Finfish, Invertebrates, and EFH.	The Proposed Action would increase vessel noise primarily during construction but also during operations and decommissioning. While vessel noise could have local, temporary impacts on commercial fish species, fishery-level impacts are unlikely. Vessel noise would have **negligible** impacts on commercial fisheries and for-hire recreational fishing.	Since vessel noise from the Proposed Action is anticipated to cause local, temporary impacts on finfish and invertebrates, fishery-level impacts would be **negligible**. Vessel noise from ongoing activities, future non-offshore wind activities, and future offshore wind activities other than the proposed Project, is also expected to cause local, temporary impacts on commercial fish species and likely no fishery-level impacts. Cumulative impacts, equal to the sum of all these impacts, are anticipated to result in no noticeable change to the condition of finfish and invertebrates in the analysis area; therefore, fishery-level impacts would be **negligible**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance, including dredging. Port utilization is expected to increase over the next 30 years.	Ports would need to perform maintenance and upgrades to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size. Port utilization is expected to increase over the next 30 years, with increased activity during construction. The ability of ports to receive the increase in vessel traffic may require port modifications, such as channel deepening, leading to local impacts on fish populations. Port expansions could also increase vessel traffic and competition for dockside services, which could affect fishing vessels.	At least two projects are contemplating port expansion/modification, in Vineyard Haven and in Montauk. It is likely that other ports would be upgraded along the East Coast, and some of this may be attributable to supporting the offshore wind industry. Expansion of port facilities could increase vessel traffic, increasing the potential for navigational hazards to fishing vessels. An increase in vessel traffic in ports during construction could result in delays or restrictions in access to ports, which could temporarily affect commercial and for-hire fisheries. South Fork Wind would like to dredge the O&M facility that will be established on Long Island. Fishing vessels may have restrictions and delays accessing port facilities during maintenance dredging. The risk would increase during maintenance, which occurs infrequently. Section 3.4.1.1 discusses port expansion impacts on fish, invertebrates, and EFH.	The Proposed Action is not anticipated to cause any port expansion, but it could cause an increase in vessel traffic in ports and resulting delays or restrictions in access to ports due to increased vessel use during construction. This would have localized, short-term, **minor** impacts on commercial and for-hire fisheries. Vineyard Wind's proposed marine coordinator and vessel traffic management plan are expected to mitigate the risks for impacts from increased traffic congestion and competition for dockside services such that impacts on commercial and for-hire fisheries would be **minor**.	The Proposed Action is not anticipated to cause any port expansion or otherwise affect commercial fisheries or for-hire recreational fishing near ports. Ongoing and future non-offshore wind activities are expected to cause impacts on fishing vessels through this sub-IPF by increasing vessel traffic at ports and by competition for dockside services. Future offshore wind activities other than the proposed Project are expected to cause impacts through this sub-IPF on commercial fisheries and for-hire recreational fishing that are the same as above. No cumulative impacts of this sub-IPF on commercial fisheries and for-hire recreational fishing can be attributed to the Proposed Action, although ongoing and future activities are expected to result in increased vessel traffic and competition for port services.
Presence of structures: Navigation hazard and allisions	Structures within and near the cumulative lease areas that pose potential navigation hazards include the Block Island Wind Farm WTGs, buoys, and shoreline developments such as docks and ports. An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. Two types of allisions occur: drift and powered. A drift allision generally occurs when a vessel is powered down due to operator choice or power failure. A powered allision generally occurs when an operator fails to adequately control their vessel movements, or is distracted.	No known reasonably foreseeable structures are proposed to be located in the geographic analysis area that could affect commercial fisheries. Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.	Development of the projects in the geographic analysis area would install more buoys, met towers, and foundations. The addition of up to 2,066 new structures from this sub-IPF will increase navigational complexity, the risk of navigation hazards, as well as the number of collisions and allisions for vessels transiting through or operating within lease areas over an assumed 6- to 10-year construction period and remain constant throughout operations until decommissioning. During the construction and operations periods for future offshore wind projects, these impacts will hinder SAR capability. The capability to conduct SAR would be further hindered if one or more projects in the RI and MA Lease Areas do not align with a uniform 1 x 1 nautical mile WTG spacing with east–west/north–south orientation. The combined effect of increased risk of navigational hazards with the hindrance of SAR capability in a non-uniform scenario will increase the risk of fatalities. Fishing vessels that decide to fish or transit within a lease area run the risk of allisions with structures. Actively fishing with mobile gear results in decreased vessel maneuverability, increasing allision risk in WDAs. The risk would increase as additional offshore wind energy projects are built, which would limit the ocean surface available for transiting and fishing. Fishing in the WDAs would not be as problematic for for-hire recreational fishing vessels that bottom-fish with hook and line gear as the vessels are generally over a fixed location or under a controlled drift. However, fishing for highly migratory species 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, poses additional maneuverability challenges. Figures 3.11-1 through 3.11-6 show the directionality of fishing vessel activity based on VMS data. It includes all VMS-equipped vessels, parsed into two speed categories (≥ 5 knots and < 5 knots) representing transiting and fishing activity. These plots show variability between activity type and fishery, and between the proposed Project WDA versus the cumulative southern New England leases.	The Proposed Action is expected to add up to 102 foundations, which are navigation hazards during construction and throughout operations. The location of the proposed infrastructure within the WDA could affect transit corridors and access to preferred fishing locations. Maneuverability within the WDA would vary depending on many factors (e.g., vessel size, gear or method used, environmental conditions). The risk of damage or loss of deployed gear as a result of operations and maintenance is expected to have an impact on mobile gear commercial fisheries and for-hire fishing due to striking (allision) or hooking gear on proposed infrastructure. Larger commercial fishing vessels with mobile gear are the most at risk for an allision, as they are the most limited in maneuverability. Figure 3.11-3 shows the directionality of fishing vessel activity based on VMS data within the proposed Project WDA. A majority of the 538 unique vessels are transiting or fishing in a northwest–southeast direction through the WDA. The potential changes to vessels' transit routes and chosen fishing locations could have a long-term, **moderate** impact on commercial fisheries and for-hire recreational fishing due to the increased time navigating around the area and fuel costs.	The risk of impacts from this sub-IPF is affected by the amount and layout of structures, increases in recreational fishing vessels due to changes in areas of fish species aggregation, as well as changes in operational planning for vessels resulting in increased space use conflicts (see Presence of structures: Space use conflict sub-IPF below). The Proposed Action would add up to 102 foundations under various layout options, resulting in long-term, **moderate** impacts on all vessels transiting through or around the WDA. Existing structures and future non-offshore wind structures in the cumulative analysis area pose an additional risk to all vessels that may also operate in the WDA. Future offshore wind activities excluding the Proposed Action would add vertical surfaces of up to 2,066 new foundations. The cumulative impacts from the presence of structures on navigation hazards with the Proposed Action when combined with past, present, and reasonably foreseeable future activities would be **major** on commercial and for-hire recreational fisheries if offshore wind projects in the RI and MA Lease Areas do not all adopt a uniform 1x1 nautical mile WTG spacing with east–west/north–south orientation.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb habitats and potentially harm individuals, creating small, localized, short-term impacts on fish, but likely no impacts at a fishery level.	No future activities were identified within the analysis area other than ongoing activities.	Development of the projects in the geographic analysis area would install more buoys, met towers, foundations, and hard protection. Approximately 1,221 acres (4.9 km^2) of hard protection atop cables, 1,723 acres (7.0 km^2) of foundation scour protection, and the vertical surfaces of up to 2,066 new foundations would increase the risk of gear loss/damage by entanglement and the ensuing impacts on commercial fisheries and for-hire recreational fishing, which would increase during the construction period and be intermittent over 30 years. The intermittent impacts at any one location would likely be difficult to detect, localized, and short-term, although the risk of occurrence would persist as long as the structures remain.	The Proposed Action is expected to add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations would remain for the life of the Project, and scour/cable protection would likely remain permanently. This 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). Concrete mattresses covering cables in hard-bottom areas (estimated to be less than 10% of OECC and inter-array cable route length—Draft EIS Section 2.1.1) could hinder commercial trawlers/dredgers over the long term. **Moderate** adverse impacts at any one location would likely be localized, although the risk of occurrence would persist as long as the structures remain. Additionally, the Proposed Action has established gear loss and revenue compensation funds for Rhode Island fishing interests to mitigate gear and/or revenue losses over the life of the Project (Table 3.11-5).	The risk of impacts from this sub-IPF is proportional to the amount of structure present. The Proposed Action would add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection, resulting in localized **moderate** impacts on commercial fisheries and for-hire recreational fishing. Future offshore wind activities other than the proposed Project would add additional scour/cable protection and vertical surfaces. Cumulatively, up to 2,066 foundations and 2,944 acres (11.9 km^2) of scour/cable protection would increase the risk of highly localized, periodic, **moderate** to **major** impacts on commercial fisheries and for-hire recreational fishing. The extent of the impacts would depend on vessel size, fishing gear, and foundation locations.
Presence of structures: Habitat conversion and fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. A large portion is homogeneous sandy seascape but there is some other hard and/or complex habitat. Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat. Structure-oriented fishes are attracted to these locations. These impacts are local and can be short-term to permanent. Fish aggregation may be considered adverse, beneficial, or neither. Commercial and for-hire recreational fishing can occur near these structures. For-hire recreational fishing is more popular, as commercial mobile fishing gear risk snagging on the structures.	New cables, installed incrementally in the analysis area over the next 20 to 30 years, would likely require hard protection atop portions of the route (see New cable emplacement/maintenance IPF above). Any new towers, buoys, or piers would also create uncommon relief in a mostly flat seascape. Structure-oriented species could be attracted to these locations. Structure-oriented species would benefit (Claisse et al. 2014, Smith et al. 2016). This may lead to more and larger structure-oriented fish communities and larger predators opportunistically feeding on the communities, as well as increased private and for-hire recreational fishing opportunities. Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). These impacts are expected to be local and may be long-term.	See above for quantification. New structures, increasing over an assumed 6- to 10-year period, could attract structure-oriented fish species for as long as the structures remain during operations. Abundance of certain fishes may increase (Claisse et al. 2014, Smith et al. 2016). Such changes could increase for-hire recreational fishing opportunities and concentrate fishing efforts, which may result in increased gear conflicts for commercial fishing vessels that choose to fish within WDAs. Section 3.4.11 discusses impacts on finfish and invertebrates.	The Proposed Action is expected to add up to 102 foundations and 151 acres (0.6 km^2) of scour/cable protection. Foundations would be decommissioned at the end of the project while scour/cable protection may remain on the seabed. The 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, and Atlantic cod); however, the local biomass increases are not anticipated to be significant enough to impact total quotas. 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 result in increased space use conflicts between commercial and recreational fishing. Section 3.4 discusses impacts on fishery resources. These impacts would be both beneficial and adverse, likely resulting in **minor** impacts on commercial fisheries and **negligible** to **minor** impacts on for-hire recreational fisheries. Impacts are expected to be local and may be short-term to permanent.	See above for quantification. The Proposed Action is expected to cause **minor** impacts on commercial fisheries and **negligible** to **minor** impacts on for-hire recreational fishing through this sub-IPF. Existing structures and future non-offshore wind structures are expected to cause localized impacts on commercial fisheries and for-hire recreational fishing through this sub-IPF. Offshore wind structures other than those associated with the Proposed Action are also expected to cause localized impacts on commercial fisheries and for-hire recreational fishing through this sub-IPF. Cumulatively, this sub-IPF is anticipated to cause **minor** impacts on commercial fisheries and for-hire fishing and **negligible** to **minor** impacts on for-hire recreational fishing that may be short-term to permanent; BOEM does not anticipate that this sub-IPF would result in considerable changes in fish distributions across the analysis area.
Presence of structures: Migration disturbances	Human structures in the marine environment, e.g., shipwrecks, artificial reefs, buoys, and oil platforms, can attract finfish and invertebrates that approach the structures during their migrations. This could slow species migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure (Secor et al. 2018). There is no evidence to suggest that structures pose a barrier to migratory animals.	The infrequent installation of future new structures in the marine environment over the next 30 years may attract finfish and invertebrates that approach the structures during their migrations. This could tend to slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement (Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded. Therefore, fishery-level impacts are not anticipated.	See above for quantification. New structures would be added intermittently over an assumed 6- to 10-year period and could tend to slow migration of some migratory species. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure (Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded. Therefore, there would not be impacts on migrations that would affect commercial or for-hire fisheries.	See above for quantification. Foundations would remain for the life of the Project, and scour/cable protection would likely permanently remain. This could tend to slow migration. However, temperature is expected to be a bigger driver of habitat occupation and species movement (Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded. Therefore, this impact is anticipated to be **negligible**.	See above for quantification. The Proposed Action is expected to present a **negligible** risk of slowing migrations of fish and invertebrates, and temperature is expected to be a bigger driver of species movement. Therefore, migratory animals would likely be able to proceed from structures unimpeded and fishery-level impacts are unlikely. Existing structures, future non-offshore wind structures, and Offshore wind structures other than those associated with the proposed Project are also expected to present a **negligible** risk of slowing migrations of fish and invertebrates. Cumulatively, the presence of many distinct structures could increase the time required for migrations; however, the small scale of disturbance (minutes) would likely have **negligible** impacts on commercial fisheries and for-hire recreational fishing.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Space use conflicts	Current structures do not result in space use conflicts.	No known reasonably foreseeable structures are proposed for location in the geographic analysis area that could affect commercial fisheries and for-hire recreational fishing.	Development of the projects in the expanded cumulative scenario would install more buoys, met towers, foundations, and hard protection. See above for quantification. New structures would be added intermittently over an assumed 6- to 10-year period and remain throughout operations for 30 years. The location of proposed offshore wind projects would affect the accessibility and availability of fish for commercial and for-hire recreational fishing. Space use conflicts could cause temporary or permanent reductions 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 WDA or OECC may increase conflict among fishermen as other areas are encroached. The competition is expected to be higher for less-mobile species (e.g., lobster, crab, surfclam/ocean quahog, and scallop). The additional structures could lead to fish aggregation of structure-oriented species, increasing the opportunity for the for-hire recreational fishery. This could contribute to space use conflicts with the commercial fisheries within the WDAs. Revenue exposed to offshore wind development in the New England and Mid-Atlantic regions by FMP for 2020-2030 quantifies this sub-IPF (Table 3.11-3).	See above for quantification. New structures would be added intermittently over the construction period and remain throughout operations for 30 years. Potential displacement of fishing vessels and increased competition on fishing grounds would have a long-term impact on commercial fisheries and for-hire recreational fishing. 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 WDA or OECC may increase conflict among fishermen as other areas are encroached. The competition is expected to be higher for less mobile species (e.g., lobster, crab, surfclam/ocean quahog, and scallop). The additional structures could lead to fish aggregation of structure-oriented species, increasing the opportunity for the for-hire recreational fishery. This could contribute to space use conflicts with the commercial fisheries within the WDAs (Draft EIS Section 3.4.5.3 for additional discussion).	The impacts from this sub-IPF are proportional to the amount and location of structure present. The Proposed Action would add up to 102 foundations, resulting in localized, short-term or long-term, **moderate** impacts to commercial fisheries and **minor** to **moderate** for-hire recreational fishing. Future offshore wind activities other than the proposed Project would add additional vertical surfaces. Cumulatively, up to 2,066 foundations would increase the risk of highly localized, periodic short-term or long-term, **moderate** to **major** impacts on commercial fisheries and **minor** to **moderate** impacts on for-hire recreational fishing.
Presence of structures: Transmission cable infrastructure	The existing offshore cable infrastructure supports the economy by transmitting electric power and communications between mainland and islands. Two subsea cables cross the far western portion of OCS-A 0487. These cables are associated with a larger network of subsea cables that make landfall near Charlestown, Massachusetts. These cables are near the Block Island Wind Farm and cross the Block Island Wind Farm export cable. Shoreline developments are ongoing and include docks, ports, and other commercial, industrial, and residential structures.	No known proposed structures (other than those associated with offshore wind development) are reasonably foreseeable and proposed to be located in the geographic analysis area for this resource.	See above for quantification. Installation of offshore cables for offshore wind facilities would increase intermittently over an assumed 6- to 10-year period and would require temporary rerouting of all vessels away from areas of active construction. These activities would temporarily affect commercial and for-hire fisheries. During operations, periodic maintenance could have similar impacts, although these activities would be less frequent and extensive than installation. Inter-array and export cables would be buried below the seabed approximately 4 to 6 feet (1.2 to 1.8 meters); however, no more than 10% of the cables may not achieve the proper burial depth and would require cable protection in the form of rock placement, concrete mattresses, and/or half-shells. Mobile bottom-tending gear (trawl and dredge gear) could be caught on these cable protection measures and the cost of these impacts would vary depending on the extent of damage to the fishing gear.	See above for quantification. Fishing vessels would need to temporarily avoid the portions of the OECC route undergoing active construction. The New Hampshire Avenue landfall would require OECC route through Lewis Bay, one of the densest marine traffic areas near the proposed Project for ferry and recreational vessels. During operations, vessels would need to avoid areas of temporary maintenance and repair. The conversion of soft sediment to hard bottom via protective cover could negatively affect the bottom trawl industry by increasing the risk of net hangs and vessel instability. Cable protection measures (e.g., concrete mattresses) covering cables in hard-bottom areas (estimated to be less than 10% of OECC and inter-array cable route length—Draft EIS Section 2.1.1) could hinder commercial trawlers/dredgers over the long term if the gear gets caught on them. The risk of damage or loss of deployed gear as a result of operations and maintenance is expected to have an impact on mobile bottom gear commercial fisheries due to striking or hooking on proposed infrastructure. Impacts on commercial fisheries and for-hire recreational fishing are anticipated to be **minor**.	The risk of impacts from this sub-IPF is proportional to the amount of cable infrastructure present. The Proposed Action would add up to 151 acres (0.6 km^2) of scour/cable protection, which would cause short-term impacts on fishing activities during installation and potentially local, long-term, **minor** impacts on commercial fisheries that use mobile bottom gear. Future offshore wind activities other than the proposed Project would add additional scour/cable protection. Cumulatively, up to 2,944 acres (11.9 km^2) of scour/cable protection would increase the risk of highly localized, periodic short-term impacts on fishing activities during installation and potentially long-term **minor** to **moderate** impacts on commercial fisheries that use mobile bottom gear.
Traffic: Vessels and vessel collisions	No substantial changes are anticipated to the vessel traffic volumes. The study area would continue to have numerous ports and the extensive marine traffic related to shipping, fishing, and recreation would continue to be important to the region's economy. The region's substantial marine traffic may result in occasional collisions. Vessels need to navigate around structures to avoid allisions. When multiple vessels need to navigate around a structure, then navigation is more complex, as the vessels need to avoid both the structure and each other. The risk for collisions is ongoing but infrequent.	New vessel traffic in the geographic analysis area would consistently be generated by proposed barge routes and dredging demolition sites. Marine commerce and related industries would continue to be important to the regional economy.	Development of the projects in the geographic analysis area would increase vessel traffic. An increase in vessel volume could result in increased traffic congestion, delays, difficulties with navigating, and an increased risk for collisions, especially for large commercial fishing vessels towing large mobile gear. However, future offshore wind projects would result in only a small incremental increase in vessel traffic, with a peak during project construction over a 6- to 10-year timeframe.	An increase in vessel volume could result in traffic congestion and an increased risk for collisions. The Proposed Action would result in a small incremental increase in vessel traffic, with a peak during project construction. During construction and installation, Vineyard Wind anticipates an average of approximately 25 vessels operating during a typical workday in the WDA and along the OECC, including an estimated 18 vessel trips per day to or from ports. Additionally, Vineyard Wind's proposed marine coordinator and vessel traffic management plan are expected to mitigate those risks. Therefore, impacts on commercial fisheries and for-hire recreational fishing are anticipated to be **minor**.	The Proposed Action is expected to cause a small incremental increase in vessel traffic, specifically an average of approximately 25 vessels operating during a typical workday in the WDA and along the OECC. Therefore, fishery-level impacts are anticipated to be **minor**. Ongoing and future non-offshore wind activities are expected to cause temporary impacts through this sub-IPF on commercial fisheries and for-hire recreational fishing. Future offshore wind activities other than the proposed Project are expected to cause temporary impacts through this sub-IPF on commercial fisheries and for-hire recreational fishing during project construction. Cumulatively, this sub-IPF is anticipated to cause an incremental increase in vessel traffic during construction over a 6- to 10-year timeframe, resulting in **minor** to **moderate** impacts on commercial fisheries and for-hire recreational fishing.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Climate change	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the distributions of species that are important for commercial and for-hire recreational fisheries. If the distribution of important fish stocks changes, it could affect where commercial and for-hire recreational fisheries are located, and could potentially increase the cost of fishing if transiting time increases. Continuous CO_2 emissions causing ocean acidification may contribute to reduced growth, or the decline of, invertebrates that have calcareous shells over the course of the next 30 years. Over time, this could potentially directly affect species that are important for commercial and for-hire recreational fisheries or their prey species.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	Impacts are the same as under Ongoing Activities. See Appendix A Section A.8.1 for the contribution of these activities to climate change.	This IPF may contribute to reduced growth or the decline of fish and invertebrates, leading to impacts on commercial fisheries and for-hire recreational fishing. Because this IPF is a global phenomenon, impacts on commercial fisheries and for-hire recreational fishing though this IPF would be the same for the Proposed Action, ongoing activities, future non-offshore wind activities, and future offshore wind activities. See Appendix A Section A.8.1 for the cumulative contribution of these activities to climate change.
Regulated fishing effort	Commercial and recreational regulations for finfish and shellfish implemented and enforced by NOAA Fisheries and coastal states, affect how the commercial and for-hire recreational fisheries operate. Commercial and recreational for-hire fisheries are managed by FMPs, which are established to manage fisheries to avoid overfishing through catch quotas, special management areas, and closed area regulations. These can reduce or increase the size of available landings to commercial and for-hire recreational fisheries.	Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the North Atlantic right whale by 60% (McCreary and Brooks 2019). This will likely have a significant impact on fishing effort in the lobster and Jonah crab fisheries in the geographic analysis area for this resource. See Baseline Conditions for additional fishery management actions that will affect commercial fisheries and for-hire recreational fishing.	Offshore wind development could influence this IPF and contribute to short-term and long-term impacts on commercial fisheries and for-hire recreational fisheries operations. The impacts would vary depending on the fishery, and the changes in fishing behavior due to offshore wind development. Future offshore wind could influence fisheries scientific surveys and may result in more conservative quota and effort management measures. Impacts on the management process would affect the commercial and for-hire recreational fisheries operations. Fishing regulations may have less flexibility in area-based management due to offshore wind projects, and offshore wind may change the distribution of fishing effort in ways not contemplated in FMPs.	The incremental impacts of the Proposed Action with fisheries regulations would increase impacts on commercial fisheries and for-hire recreational fishing beyond those of the No Action Alternative. However, the extent of impacts from offshore wind development on regulated fishing effort is difficult to predict. The impacts would vary depending on the fishery, and the changes in fishing behavior due to offshore wind development. The Proposed Action could influence fisheries scientific surveys and may result in more conservative quota and effort management measures. Impacts on the management process would impact the commercial and for-hire recreational fisheries operations. Fishing regulations may have less flexibility in area-based management due to the Proposed Action, and offshore wind may change the distribution of fishing effort in ways not contemplated in FMPs. Therefore, impacts on commercial fisheries and for-hire recreational fishing are anticipated to be **moderate**.	This IPF would contribute to short-term and long-term impacts on commercial fisheries and for-hire fishing. The intensity of impacts on commercial fisheries and for-hire recreational fishing under future fishing regulations are uncertain, but would likely be similar to the *status quo,* as maximum sustainable yield remains the management objective. However, the incremental impacts of the Proposed Action with fisheries regulations would likely have short-term or long-term **moderate** impacts on commercial fisheries and for-hire recreational fishing as management adapts to changing data and management options. Ongoing and future non-offshore wind activities are expected to have similar impacts or greater than the *status quo*. Future offshore wind activities other than the proposed Project are expected to cause an incremental increase in impacts through this IPF on commercial fisheries and for-hire recreational fishing as management adapts to changing data and management options. Cumulatively, this IPF is anticipated to cause **moderate** impacts on commercial fisheries and for-hire recreational fishing.

BOEM = Bureau of Ocean Energy Management; COP = Construction and Operations Plan; EIS = Environmental Impact Statement; FMP = fisheries management plan; G&G = Geological and Geophysical; GHG = greenhouse gas; IPF = impact-producing factors; km^2 = square kilometers; met, meteorological; NMFS = National Marine Fisheries Service; NOAA = National Oceanic and Atmospheric Administration; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor; RI and MA Lease Area = Rhode Island and Massachusetts Lease Areas; SAR = search and rescue; VMS = vessel monitoring system; WDA = Wind Development Area; WTG = wind turbine generator

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Table 3.11-2: Value and Volume of Commercial Fishery Landings by Port (2016-2018; nominal dollars)

Port	2016	2017	2018	2016	2017	2018
	Pounds (millions)			Value (millions $)		
New Bedford, Massachusetts	106.6	110.8	113.5	326.5	389.5	431.1
Cape May-Wildwood, New Jersey	46.6	101.6	101.2	84.7	81	66.3
Point Judith, Rhode Island	53.4	44.3	47.5	55.7	57.4	63.7
Hampton Roads Area, Virginia	12.3	15.5	14.7	61	58.1	54.7
Gloucester, Massachusetts	63.4	63.9	59	52.4	52.6	53.2
Provincetown-Chatham, Massachusetts	26.5	22.3	22.5	32.8	33.8	34.8
Reedville, Virginia	321.3	319.9	352.5	31.2	32.5	36.2
Point Pleasant, New Jersey	26.3	37.5	43.3	32.1	35.3	32.4
Long Beach-Barnegat, New Jersey	7.2	7.6	6.3	26.9	24.7	24.3
Atlantic City, New Jersey	24.3	24.7	24.8	19.7	18.6	18.2
Boston, Massachusetts	12.2	15.8	17	17	17.3	16.4
Montauk, New York	11.8	10.1	11.3	16.3	14.8	17.3
North Kingstown, Rhode Island	17.6	27	22.8	13.7	17.7	16
Accomac, Virginia	7.6	5.9	6.2	20.1	12.8	12.1
Fairhaven, Massachusetts	3.9	3.2	3.2	21.8	10.3	8.4
Newport, Rhode Island	6.6	7.3	5.5	8	8.5	7.9
Hampton Bay-Shinnicock, New York	5.2	3.8	3.6	8	6.1	5.7
Ocean City, Maryland	4	4.4	4.2	5.7	4.6	4.8
Stonington, Connecticut	2.1	1.8		5.9	6.2	
New London, Connecticut	9	5.6	7.2	5.1	2.7	4.2
Chincoteague, Virginia	2.4	1.9		4.9	3.9	
Belford, New Jersey	2.5	5.1	4.9	3	2.7	1.9
Little Compton, Rhode Island			3.1			2.9
Cape Charles-Oyster, Virginia		0.3			1.1	
Greenport, New York		0.2			0.3	

Source: NOAA 2019a, NOAA 2019c

Table 3.11-3: Average Annual Percentage of Total Mid-Atlantic and New England Fishery Revenue Exposed to Offshore Wind Energy Development by FMP (2020-2030)

FMP	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2030*
Atlantic herring	0.00%	0.05%	0.29%	0.40%	0.44%	0.71%	0.71%	0.75%	0.75%	0.75%	0.75%	$194,175
Bluefish	0.00%	0.08%	0.47%	0.61%	0.66%	0.99%	1.18%	1.20%	1.20%	1.20%	1.28%	$18,322
Golden tilefish	0.00%	0.03%	0.06%	0.39%	0.48%	1.06%	1.06%	1.06%	1.06%	1.06%	1.06%	$49,716
HMS	0.00%	0.00%	0.04%	0.07%	0.07%	0.08%	0.10%	0.10%	0.10%	0.10%	0.13%	$2,262
Mackerel/squid/butterfish	0.00%	0.45%	0.83%	1.29%	1.31%	2.34%	2.38%	2.47%	2.47%	2.47%	2.56%	$1,160,421
Monkfish	0.00%	0.30%	2.57%	2.97%	2.98%	4.53%	4.57%	4.62%	4.62%	4.62%	4.70%	$904,187
Multispecies large mesh	0.00%	0.04%	0.28%	0.31%	0.32%	0.45%	0.45%	0.45%	0.45%	0.45%	0.45%	$300,026
Multispecies small mesh	0.00%	0.39%	1.52%	2.36%	2.37%	4.20%	4.21%	4.22%	4.22%	4.22%	4.22%	$442,456
Sea scallop	0.00%	0.01%	0.11%	0.29%	0.29%	0.51%	0.59%	0.75%	0.75%	0.75%	0.77%	$3,538,272
Skate	0.00%	0.45%	4.26%	4.74%	4.77%	6.98%	7.03%	7.04%	7.04%	7.04%	7.08%	$582,748
Spiny dogfish	0.00%	0.11%	1.33%	1.40%	1.67%	1.96%	2.10%	2.11%	2.11%	2.11%	2.13%	$57,465
Summer flounder/scup/black sea bass	0.00%	0.16%	0.92%	1.38%	1.47%	2.39%	2.50%	2.56%	2.56%	2.56%	2.70%	$991,601
Surfclam/ocean quahog	0.00%	0.20%	1.33%	1.48%	1.50%	2.34%	5.17%	5.20%	5.20%	5.20%	5.30%	$3,329,762
None – Unmanaged (includes lobster and Jonah crab)	0.00%	0.05%	0.38%	0.50%	0.57%	1.03%	1.07%	1.08%	1.08%	1.08%	1.21%	$1,476,467
Red crab	0.00%	0.00%	0.03%	0.11%	0.14%	0.23%	0.25%	0.25%	0.25%	0.25%	0.33%	$10,381

Source: G. DePiper, Pers. Comm., 2018

FMP = Fisheries Management Plan; VTR = Vessel Trip Report

Notes: Data is in 2019 dollars. The data represents the revenue-intensity raster developed using fishery dependent landings' data. To produce the data set, VTR information was merged with data collected by at-sea fisheries observers, and a cumulative distribution function was estimated to present the distance between VTR points and observed haul locations. This provided a spatial footprint of fishing activities by FMPs. The percentages are expected to continue after 2030 until facilities are decommissioned. American lobster and Jonah crab fisheries are included in the "None – Unmanaged" row.

*This column represents the total average revenue exposed in 2030 in order to give a value reference to for the percentage of revenue exposed in 2030.

Table 3.11-4: Average Annual Revenue from all Lease Areas for Exposed Port Groups, 2013-2018

State Landed	Port Landed	Average Annual Revenue from all Lease Areas	Average Percent of Port Revenue
Massachusetts	New Bedford	$2,866,630	1%
Rhode Island	Point Judith	$2,401,731	5%
New Jersey	Atlantic City	$867,267	4%
New Jersey	Cape May	$795,656	1%
Rhode Island	Little Compton	$392,608	22%
New Jersey	Point Pleasant	$358,783	2%
New York	Montauk	$307,661	2%
Rhode Island	Newport	$307,129	4%
New Jersey	Barnegat	$224,674	1%
Massachusetts	Westport	$175,404	16%
Massachusetts	Fairhaven	$173,077	2%
Maryland	Ocean City	$158,460	3%
New Jersey	Sea Isle City	$144,291	8%
Virginia	Newport News	$138,144	1%
Virginia	City of Seaford	$126,244	1%
Connecticut	New London	$98,615	2%
Virginia	Hampton	$92,523	1%
Massachusetts	Chatham	$88,490	1%
Connecticut	Stonington	$71,916	1%
Rhode Island	Tiverton	$70,402	5%
Rhode Island	Davisville	$61,687	1%
Rhode Island	North Kingstown	$53,545	1%
Delaware	Indian River	$45,930	13%
North Carolina	Beaufort	$43,292	1%
Massachusetts	Menemsha	$41,284	10%

Source: B. Galuardi, Pers. Comm., 2020

Table 3.11-5: Vineyard Wind's Financial Compensation Agreements

Measure	Description	Proposed Project Phase
Rhode Island Compensation Fund[a]*	A $4.2 million direct compensation fund to be held in escrow to compensate for any claims of direct impacts on Rhode Island vessels or Rhode Island fisheries interests[b] in the Project area.	Construction, Operations and Maintenance, and Decommissioning
Massachusetts Compensation Fund[a]*	A $19.2 million direct, downstream and cumulative (upstream) compensation fund to be held in escrow to compensate for any claims of direct or indirect impacts on Massachusetts vessels or Massachusetts fisheries interests[b] in the Project area.	Construction, Operations and Maintenance, and Decommissioning
Rhode Island Fisherman's Future Viability Trust*	Vineyard Wind entered into an agreement with the Rhode Island Coastal Resources Council regarding the establishment and funding of the Rhode Island Fishermen's Future Viability Trust (the "Trust"). The purpose of the $12.5 million Trust is to further the policies of the Ocean Special Area Management Plan with respect to the continued viability and success of Rhode Island's fishing industry and to support and promote the compatibility of offshore wind and commercial fishing interests within Rhode Island's Geographic Location Description. The Trust will provide funds to address concerns about safety and effective fishing in and around the Project area and wind farms generally. Examples of how the funds may be used include improvements in fishing vessels, fishing methods, and gear, supporting widespread deployment of navigational equipment, financial support of individual fisherman, purchase of updated safety equipment (e.g., radar, global positioning systems, survival suits, life rafts, etc.), and payment for increased insurance costs related to fishing around wind farms.	Construction, Operations and Maintenance, and Decommissioning
Massachusetts Fisheries Innovation Fund*	On May 21, 2020, the Massachusetts Executive Office of Energy and Environmental Affairs and Vineyard Wind entered into Memorandum of Agreement for a $1.75 million Fisheries Innovation Fund. The purpose of the Fisheries Innovation Fund is to support programs and projects that ensure safe and profitable fishing continue as Vineyard Wind and future offshore wind projects are developed in Northern Atlantic waters. The Fund will provide support to programs and projects through grants to conduct studies on the impacts of offshore wind development on fishery resources and the recreational and commercial fishing industries as well as provide grants for technology and innovation upgrades for fishery participants (and vessels) actively fishing within a wind energy area. These programs and projects may include, but are not limited to, studies on the impacts of offshore wind development on fishery resources and the recreational and commercial fishing industries, improvements in fishing vessels and gear, development of new technology to improve navigation in and around the wind farm area, the development of alternative gear and fishing methods, optimization of vessel systems, technology and innovation upgrades for fishery participants (and vessels) actively fishing within a wind energy area, and general fishing vessel safety improvements.	Construction, Operations and Maintenance, and Decommissioning

Sources: Epsilon 2019; Vineyard Wind 2020

[a] The $25.4 million is calculated as follows: Rhode Island economic exposure was valued at $6,190,281 over 30 years using a 2.5 percent annual escalator to the initial 1-year exposure value. When the Rhode Island Fisheries Advisory Board asked to front-load the initial payment, the amount in nominal dollars was reduced to $4.2 million (but the value in real terms is still $6.1 million). For Massachusetts, the economic exposure plus upstream and downstream multipliers is $19,185,016. The Rhode Island $6,190,281 plus the Massachusetts $19,185,016 equals $25,375297. The $25.4 million compensation funds are calculated from Fishing Vessel Trip Reports, Dealer Reports, and Vessel Monitoring System data (http://www.crmc.ri.gov/windenergy/vineyardwind/VW_EconExposureCommFisheries.pdf and the Memorandum of Agreement between Vineyard Wind and the Massachusetts Executive Office of Energy and Environmental Affairs, for detailed methodology).

[b] Fishing interests are broadly defined to include vessel owners and operators, vessel crews, shoreside processors, vessel supplier and support services, and other entities that can demonstrate losses directly related to the Vineyard Wind 1 Project.

* This voluntary measure was included in the May 2019 COP Addendum to Volume III and in the May 21, 2020, Memorandum of Agreement between Vineyard Wind and the Massachusetts Executive Office of Energy and Environmental Affairs and executed by the Massachusetts Office of Coastal Zone Management. The COP approval for the proposed Project will require compliance with consistency concurrence under the Coastal Zone Management Act (COP Addendum to Volume III, Epsilon 2019).

Table 3.12-1: Summary of Activities and the Associated Impact-Producing Factors for Land Use and Coastal Infrastructure

Baseline Conditions: Land use in the study area is diverse, encompassing many distinct environments, including wetlands, developed areas, forests, and agricultural land. Developed coastal areas are common, due to the presence of large coastal population centers, including recreational, tourism, residential, commercial, and industrial infrastructures (NOAA 2010). NOAA estimates that 9 percent of the Northeast Coastal Region (which includes the study area) is developed; however, this is highly concentrated around high intensity development urban areas. From 1996 to 2010, developed land has increased (NOAA 2010). The developed areas of the Northeast are primarily along the coast, including major metropolitan areas like Boston and New York. The USACE identifies 15 principal ports along the North Atlantic coast (USACE 2018). For offshore wind energy development, New Bedford, Massachusetts, has a purpose-built terminal for offshore wind that was completed in 2015 (MassCEC 2017b). The Towns of Barnstable, Yarmouth, and Tisbury are long-established communities with a mix of low- to medium-density residential development, business areas, extensive recreation or tourist-oriented commercial and public uses, open space, and smaller areas of industrial use. The city of New Bedford is a densely developed, historic manufacturing town and port. The city's Master Plan establishes numerous goals, which include developing emerging technology industry sectors, linking brownfields and historic mills with new development opportunities, diversifying the industries in the Port of New Bedford while supporting traditional harbor industries, and promoting sustainable, mixed-use development in neighborhoods (Vanasse Hangen Brustlin, Inc. 2010).

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Accidental releases: Fuel/fluids/ hazmat	Various ongoing onshore and coastal construction projects include the use of vehicles and equipment that contain fuel, fluids, and hazardous materials that could be released.	Ongoing onshore construction projects involve vehicles and equipment that use fuel, fluids, or hazardous materials could result in an accidental release. Intensity and extent would vary, depending on the size, location, and materials involved in the release.	Accidental releases from onshore components (i.e., transformers) could affect nearby wetlands, developed areas, forests, agricultural lands, and any other adjacent land use. Nearshore accidental releases could affect the ability to use coastal infrastructure. The potential for accidental releases would continue during construction and decommissioning of offshore wind projects, and would remain lower and constant during operations.	Accidental releases from onshore construction could affect adjacent land uses (primarily developed areas). Nearshore accidental releases could affect the ability to use coastal infrastructure, such as docks. The potential for accidental releases would continue during construction and decommissioning of the Proposed Action, and would remain lower and constant during operations. This would have localized, short-term, **negligible** to **minor** impacts on land use and coastal infrastructure.	The impacts on land use and coastal infrastructure from this sub-IPF under the Proposed Action would include increased potential for accidental releases, which would have localized, short-term, **negligible** to **minor** impacts on land use and coastal infrastructure, including restriction in use of adjacent properties and coastal infrastructure during cleanup. Ongoing activities and future non-offshore wind activities would contribute similar types of impacts near construction sites. Future offshore wind activities would have similar contributions as the Proposed Action. Cumulative impacts on land use and coastal infrastructure from this sub-IPF from the Proposed Action, when combined with the past, present, and reasonably foreseeable activities, would occur if accidental releases affect the same or nearby properties or coastal areas simultaneously, and would be localized, short-term, **negligible** to **minor**.
Light: Structures	Various ongoing onshore and coastal construction projects have nighttime activities, as well as existing structures, facilities, and vehicles that would use nighttime lighting.	Ongoing onshore construction projects involving nighttime activity could generate nighttime lighting. Intensity and extent would vary, depending on the location, type, direction, and duration of nighttime lighting.	Lighting from nighttime nearshore or onshore construction or operation WTGs could affect adjacent land uses, if the lighting influences decisions of visitors in selecting coastal locations to visit or buy. WTG lighting would be visible from an increasing number of locations as each facility is installed, and then would be constant during operations.	Offshore nighttime construction of the Proposed Action, as well as lighting on all of the Proposed Action's WTGs could potentially be visible from higher elevations and some locations along the coastline of Martha's Vineyard and Nantucket, depending on vegetation, topography, weather, and atmospheric conditions. Vineyard Wind has committed to implementing ADLS as a voluntary measure, which would activate WTG lighting less than 0.1 percent of annual nighttime hours. Minimal new lighting associated with the proposed substation could affect the ability to use existing properties, including affecting visitor and residential recreation and tourism decisions, as well as decisions about where to establish permanent or temporary residences. However, the proposed substation would be constructed adjacent to an existing substation, in an industrially zoned area of Barnstable. Therefore, the substation lighting impacts on land use and coastal infrastructure are expected to be *de minimis*. Visible lighting from WTGs would have indirect, long-term, continuous, **negligible** impacts on land use and coastal infrastructure.	The impacts on land use and coastal infrastructure from this sub-IPF under the Proposed Action would be indirect, resulting from offshore nighttime construction and the potential visibility of lighting on the Proposed Action's WTGs from some beaches, coastlines, and elevated locations on Martha's Vineyard and Nantucket. The presence of these structures could potentially influence decisions made by visitors in selecting activities, facilities, and lodging, as well as potential residents selecting home locations. This would have long-term, continuous, indirect, **negligible** impacts on land use. The Proposed Action's nighttime lighting on the substation within an industrially zoned location is expected to be *de minimis*. Ongoing activities and future non-offshore wind activities would add widespread lighting on onshore structures, along with minimal offshore lighting. Onshore lighting from ongoing activities would be closer to onshore viewers (who would thus perceive onshore lighting as more intense). Onshore lighting would generally contribute the largest part of the cumulative impact of lighting on structures, except in cases where minimal onshore lighting is present. Impacts from future offshore wind activities would be similar to those of the Proposed Action but more extensive, due to lighting from up 709 WTGs potentially visible from the same locations as the Proposed Action, as well as additional coastal locations in Massachusetts and Rhode Island. Cumulative impacts on land use and coastal infrastructure from this sub-IPF from the Proposed Action when combined with the past, present, and reasonably foreseeable activities would be localized, long-term, constant, and **negligible**. Use of ADLS by offshore wind projects other than the Proposed Action would further reduce the **negligible** cumulative impacts of this sub-IPF on land use and coastal infrastructure.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The MCT at the Port of New Bedford is a completed facility developed by the port specifically to support the construction of offshore wind facilities.	Ports would need to perform maintenance and upgrade facilities to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep draft vessels as they continue to increase in size.	Offshore wind installation would require port facilities for shipping, berthing, and staging. Development activities would support ongoing or new activity at authorized ports, making productive use of these facilities throughout construction, operations, and decommissioning of offshore wind projects.	The Proposed Action would use the MCT at the Port of New Bedford for staging and shipping and facilities at Vineyard Haven Harbor on Martha's Vineyard for the Operations and Maintenance Facility. Improvements for both of these facilities have been or would be completed to support the offshore wind industry as a whole, and not the Proposed Action specifically. The Proposed Action would make active use of these facilities, as well as other ports in the geographic analysis area for land use and coastal infrastructure designated or appropriate for offshore wind activity. This would have localized, short-term (at the MCT) or long-term (at Vineyard Haven), **negligible beneficial** impacts on land use and coastal infrastructure.	The Proposed Action would not cause any port expansion but would use the MCT at the Port of New Bedford and facilities at Vineyard Haven harbor constructed to support the offshore wind industry as a whole. This would make productive use of ports designated or appropriate for offshore wind activity, and would have localized, short-term (at the MCT) or long-term (at Vineyard Haven), **negligible beneficial** impacts on land use and coastal infrastructure. Ongoing and future non-offshore wind activities would include port upgrades and expansion to support overall changes and increases in shipping and maritime commerce, which could also make productive use of designated ports. Future offshore wind activities would also have similar contributions as the Proposed Action, but in a wider range of ports. Cumulative impacts on land use and coastal infrastructure from this sub-IPF from the Proposed Action when combined with the past, present, and reasonably foreseeable activities would most frequently occur near the Port of New Bedford, which was upgraded specifically to support the offshore wind energy industry, but also at other ports in the geographic analysis area for land use and coastal infrastructure, and these impacts would be localized, short-term (at the MCT) or long-term (at Vineyard Haven), and **minor beneficial** impacts.
Presence of structures: Viewshed	The only existing offshore structures within the offshore viewshed of the Vineyard Wind are minor features such as buoys.	Non-offshore wind structures that could be viewed in conjunction with the offshore components would be limited to met towers. Marine activity would also occur within the marine viewshed.	See SEIS Section 3.10. The potential 775 offshore WTGs would be visible from south-facing coastlines and elevated locations on Nantucket, Martha's Vineyard, neighboring islands, and coastal Cape Cod. More than 95 percent of the WTGs would be over 15 miles (24 kilometers) from the closest shoreline. Impacts on land use would be indirect, related to impacts on recreation,	See SEIS Section 3.10. All of the Proposed Action's WTGs would be visible from south-facing coastlines and elevated locations on Nantucket, Martha's Vineyard, neighboring islands, and Cape Cod, depending upon vegetation, topography, and atmospheric conditions. Most WTGs would be more than 15 miles (24 kilometers) from the coastal viewers and the WTGs would not dominate offshore views, even when weather and atmospheric conditions allow views. Views of WTGs	Impacts on land use and coastal infrastructure from the Proposed Action would be indirect, resulting from views of the Proposed Action's WTGs from some beaches, coastlines, and elevated locations on Martha's Vineyard, Nantucket, and coastal Cape Cod. The presence of these structures could potentially influence decisions made by visitors in selecting activities, facilities, and lodging, as well as potential residents selecting home locations. This would have indirect, long-term, continuous, **negligible** impacts on land use. Ongoing activities and future non-offshore wind activities would not add visible offshore structures. Impacts from future offshore wind activities would be similar to those of the Proposed Action but more extensive, due to the visibility of up to 775 WTGs potentially visible from the same locations within the geographic analysis area. Cumulative impacts on land use and coastal infrastructure from this sub-IPF from the

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			tourism, and property values, if the views influence visitors in selecting coastal locations to visit or buy. The impact of onshore views of substations would depend upon the specific location, site design, and nature of neighboring land uses.	would have an indirect, long-term, continuous, **negligible** impact on land use due to potential effects on property use and value. The views of the Proposed Action's substation would have long-term, continuous, **negligible** impacts on land use due to its location within an industrial area.	Proposed Action when combined with the past, present, and reasonably foreseeable activities would be localized, long-term, constant, and **minor**. The cumulative impacts would be indirect, resulting from potential impacts on property use and value.
Presence of structures: Transmission cable infrastructure	Onshore buried transmission cables are present in the area near the Vineyard Wind 1 Project onshore and offshore improvements. Onshore activities would only occur where permitted by local land use authorities, which would avoid long-term land use conflicts.	No known proposed structures are reasonably foreseeable and proposed to be located in the geographic analysis area for land use and coastal infrastructure.	See Land Disturbance: Onshore land use changes.	See Land Disturbance: Onshore land use changes.	See Land Disturbance: Onshore land use changes.
Land disturbance: Onshore construction	Onshore construction supports local population growth, employment, and economics.	Onshore development would continue in accordance with local government land use plans and regulations.	Installation of onshore cable infrastructure would have localized, short-term impacts during construction or maintenance. Onshore construction of cables is likely to disrupt road traffic for a few days and produce noise and dust, typical of other utility construction projects. Occasional, temporary traffic delays would result from repairs/maintenance. The exact extent of impacts would depend on the locations of landfall and onshore transmission cable routes for future offshore wind energy projects.	Onshore cable installation would result in temporary traffic delays and temporary disturbance of public beaches, roads, and adjacent uses. Construction at any single location along a public road would be completed in a few days or weeks. Cable routes would generally follow or be under or adjacent to existing roads or utility ROW (Epsilon 2018a), and therefore would not change adjacent land uses or affect coastal infrastructure. Occasional, temporary traffic delays would result from repairs /maintenance. This would have localized, short-term, **minor** (Covell's Beach Landfall) to **moderate** (New Hampshire Landfall) impacts on land use and coastal infrastructure.	The Proposed Action would cause temporary noise and dust, disruptions to beach and road use, and disrupted access to properties adjacent to work areas during construction of onshore transmission cable infrastructure and occasionally during operations. This would result in localized, short-term, **minor** to **moderate** impacts on land use and coastal infrastructure. Ongoing and future non-offshore wind activities would contribute similar types of impacts as the Proposed Action, although there are no known reasonably foreseeable projects proposed in the geographic analysis area for land use and coastal infrastructure. Future offshore wind activities would also have similar contributions as the Proposed Action, but in a wider range of cable routes. Cumulative impacts on land use and coastal infrastructure from this sub-IPF from the Proposed Action when combined with the past, present, and reasonably foreseeable activities would be localized, short-term, and **minor** to **moderate**, and only occur where installation or maintenance/repair occurs simultaneously for multiple projects, and are thus expected to be rare.
Land disturbance: Onshore, land use changes	New development or redevelopment would result in changes in land use in accordance with local government land use plans and regulations.	Ongoing and future development and redevelopment is anticipated to reinforce existing land use patterns, based on local government planning documents.	No long-term changes to land use are anticipated due to the presence of underground cable conduits and substations.	The Proposed Action would not result in changed land use. Cable conduits would be installed within roads and utility ROW; the substation would be installed within an industrial area.	The Proposed Action would result in **no** changes to land use. Ongoing and future non-offshore wind activities are anticipated to reinforce existing land use patterns in the geographic analysis area. Future offshore wind activities would not change land uses if onshore cables are underground within rights-of-way and substations are within areas designated for industrial or utility uses; the actual impacts would depend on the specific locations proposed for onshore infrastructure. Cumulative impacts of offshore wind development on land use changes from this sub-IPF from the Proposed Action when combined with the past, present, and reasonably foreseeable activities is anticipated to be **negligible**.

ADLS = Aircraft Detection Light System; IPF = impact-producing factors; MCT = New Bedford Marine Commerce Terminal; met = meteorological; NOAA = National Oceanic and Atmospheric Administration; ROW = right-of-way; USACE = U.S. Army Corps of Engineers; WTG = wind turbine generator

Table 3.13-1: Summary of Activities and the Associated Impact-Producing Factors for Navigation and Vessel Traffic

Baseline Conditions: Total vessel transits in the Vineyard Wind 1 Project area have remained relatively stable since 2010. Within the WDA and the surrounding area, vessel traffic is primarily seasonal with approximately 75 percent of all annual WDA area traffic occurring between Memorial Day and Labor Day. This is primarily due to high seasonal activity by recreational vessels and commercial fishing vessels. Cargo vessel traffic is less seasonal. Traffic patterns in the vessel traffic routes within the proposed Project area are relatively stable. Tankers, tug/tow, cargo, and passenger vessels generally stay within fairways and designated traffic lanes and do not usually traverse the proposed WDA. However, 2015 to 2017 AIS maps show that a large volume of sailing, fishing, and other unspecified vessels traverse this area (Northeast Regional Ocean Council 2018).

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Anchoring	Larger commercial vessels (specifically tankers) sometimes anchor outside of major ports to transfer their cargo to smaller vessels for transport into port, an operation known as lightering. These anchors have deeper ground penetration and are under higher stresses. Smaller vessels (commercial fishing or recreational vessels) would anchor for fishing and other recreational activities. These activities cause temporary to short-term impacts on navigation in the immediate anchorage area. All vessels may anchor if they lose power to prevent them from drifting and creating navigational hazards	Lightering and anchoring operations are expected to continue at or near current levels, with the expectation of moderate increase commensurate with any increase in tankers visiting ports. Deep draft visits to major port visits are expected to increase as well, increasing the potential for an individual vessel to lose power and need to anchor, creating navigational hazards for other vessels or drifting into structures. Recreational activity and commercial fishing activity would likely stay largely the same related to this IPF.	Developers are expected to coordinate with the maritime community and USCG to avoid laying export cables through any traditional or designated lightering/anchorage areas, meaning that any risk for deep draft vessels would come from anchoring in an emergency scenario. Vessel masters would be expected to consult nautical charts, where cable locations would be marked, before dropping anchor. If a larger vessel accidently drops anchor on top of an export cable (buried or mattress protected) to prevent drifting in the event of vessel power failure, potential impacts would include damage to the export cable, any risks associated with an anchor contacting an electrified cable, and impacts on the vessel operators liability and insurance. For smaller vessels (i.e., recreational or commercial fishing vessels), cables would only pose a risk if they were not buried to the target burial depth (generally 6 to 8 feet), which smaller vessel anchors would not penetrate. When cables are surface laid or protected with concrete mattresses (generally because geologic conditions prohibit burial), vessel operators would be expected to consult nautical charts before dropping anchor. Smaller vessels anchoring within any development areas would also need to consider the foundation and any associated scour protection when dropping anchor near any WTGs.	Larger vessels that may be concerned with the export cable are not expected to pass over the cable area, transiting instead farther to the west and the south. For smaller commercial or recreational vessels, the risks would be the same as for all offshore wind installations, except only over the 151 acres (0.6 km^2) of hard cover and scour protection over foundations and cables. This would have localized, long-term continuous, **negligible** impacts on navigation and vessel traffic.	The impacts on navigation and vessel traffic from this IPF under the Proposed Action would include temporary to short-term, localized impacts due to deep draft vessels anchoring in an emergency scenario, resulting in damage to the export cable, any risks associated with an anchor contacting an electrified cable, and impacts on the vessel operators liability and insurance. Smaller vessels anchoring in the proposed Project area may have issues with anchoring failing to hold near foundations and any associated scour protection, or, alternately, where the anchors may become snagged, and potentially lost. These impacts would be localized, temporary to short-term, **negligible.** Ongoing activities and future non-offshore wind activities would contribute similar types of impacts, especially along the routes of potential cables, perhaps connecting Martha's Vineyard and/or Nantucket to the mainland. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale due to the potential for up to 775 foundations and 1.482 acres (6.0 km^2) of scour/cable protection. Cumulatively, the impacts on navigation and vessel traffic from this IPF would be similar to the Proposed Action, but would occur across the RI and MA Lease Areas and would thus be long term, continuous, and **negligible**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
	for other vessels or drifting into structures.		Anchors may have trouble holding on these surfaces, or could become snagged. For the former, the smaller vessels may need to make several attempts to get their anchor to hold. For the latter, the smaller vessels may have difficulty eventually dislodging their anchors, leading to potential loss of that anchor.		
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Impacts from these activities would be short term and could include congestion in ports, delays, and changes in port usage by some fishing or recreational vessel operators.	Ports would need to perform maintenance and perform upgrades to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep draft vessels as they continue to increase in size. Impacts would be short term and could include congestion in ports, delays, and changes in port usage by some fishing or recreational vessel operators.	Construction of offshore wind energy projects requires port facilities for staging and installation vessels, including crew transfer, dredging, cable lay, pile driving, survey vessels, and potentially feeder lift barges and heavy lift barges. These vessels would all add traffic to port facilities and would require berthing. For staging activities, developers would use large, open spaces integrated into port facilities and adjacent to sufficient berthing to unload, lay down, stage, and load the WTG, ESP, and foundation components onto feeder or heavy lift barges. Improvements to the MCT in New Bedford are unlikely to allow the MCT to simultaneously host multiple projects. This would require use of (and potential expansion, dredging, or other impacts at) other ports in Rhode Island, Connecticut, New York, Massachusetts, or beyond.	Vessel traffic generated by construction of the Proposed Action would constitute less than 10 percent of typical daily vessel transits into and out of the Port of New Bedford. Broad-beamed transfer barges or installation vessels could leave little room for other vessels to maneuver in the entry channel for the Port of New Bedford. The presence of these vessels could cause delays and changes in port usage by some fishing or recreational vessel operators. This would have localized, long-term, continuous, **moderate** impacts on navigation and vessel traffic.	The impacts on navigation and vessel traffic from this sub-IPF under the Proposed Action could include congestion at the Port of New Bedford from added vessel traffic and from the staging operations. Navigation and vessel traffic impacts due to port utilization associated with the Proposed Action would be localized, long-term, continuous, and **moderate**. The impacts from ongoing activities and future non-offshore wind activities would be of a similar nature but a greater spatial and temporal extent. Ports throughout the northeast may need upgrades to support staging operations of future offshore wind activities other than the proposed Project. Simultaneous construction may also stress port access and resources. Cumulatively, the impacts on navigation and vessel traffic through this sub-IPF are expected to be short term and regional. BOEM expects that the Proposed Action, when combined with past, present, and future projects, would have **moderate** impacts from this sub-IPF due to the short-term nature and regional potential impacts.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. There are two types of allisions that occur: drift and powered. A drift allision generally occurs when a vessel is powered down due to operator choice or power failure. A powered allision generally occurs when an operator fails to adequately control their vessel movements, or is distracted.	Absent other information, and because total vessel transits in the area have remained relatively stable since 2010, BOEM does not anticipate vessel traffic to greatly increase over the next 30 years. Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.	Wind energy projects would add potential structures for vessels to allide with in the water, including up to 955 WTGs and 20 ESPs (i.e., a total of 975 foundations) and the lift vessels used during construction (which would essentially be stationary objects while constructing each WTG). Impacts would increase as each facility is built and completed starting in 2021 and continuing through 2030, would remain constant during simultaneous operations, and would decrease as projects are decommissioned and structures are removed.	The Proposed Action would include 102 potential new structures (100 WTGs and 2 ESPs) that vessels could allide with. Additional impacts would likely be felt during the later stages of construction where there would also be heavy lift and feeder lift barges, as well as pile driving vessels, further increasing the navigational complexity and risk of allision. The layout of the Proposed Action (0.75-nautical mile spacing, with northeast-southwest and northwest-southeast rows and columns of WTGs) could complicate SAR activities and lead to abandoned SAR missions and resultant increased fatalities. This would have localized, long-term, continuous, **moderate**, impacts on navigation and vessel traffic.	The impacts on navigation and vessel traffic from this sub-IPF under the Proposed Action would include an increased allision risk and probability for smaller vessels using the area. Allisions with a WTG or an ESP could result in damage to vessels, injury to crews, engagement of USCG SAR, and vessel fuel spills. However, the layout of the Proposed Action (0.75-nautical mile spacing, with northeast-southwest and northwest-southeast rows and columns of WTGs) could complicate SAR activities and lead to abandoned SAR missions and resultant increased fatalities. This would have localized, long-term, continuous, **moderate** impacts on navigation and vessel traffic. Existing structures and future non-offshore wind structures also have localized risks of allisions with similar impacts. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Additionally, there is the potential consequence of large vessels alliding with WTGs or ESPs for offshore wind installations near ports or traffic lanes (specifically near the inbound lane of the Buzzards Bay TSS). Cumulative impacts on navigation and vessel traffic from this sub-IPF would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, with the extent of coverage increasing as additional offshore wind projects are placed in service, and would thus be long-term, continuous, regional, and **major**.
Presence of structures: Fish aggregation	Items in the water, such as ghost fishing gear, buoys, and energy platform foundations can create an artificial reef effect, aggregating fish. Recreational and commercial fishing can occur near the artificial reefs. Recreational fishing is more popular than commercial near artificial reefs as commercial mobile fishing gear can risk snagging on the artificial reef structure.	Fishing near artificial reefs is not expected to change meaningfully over the next 30 years.	Wind energy projects would add potential structures that could act as artificial reefs, including up 955 WTGs and 20 ESPs (i.e., a total of 975 foundations). As a result, wind energy projects would likely attract substantial numbers of recreational fishing vessels. These structures would be less likely to attract commercial fishing vessels, due to differences in fishing techniques. This attraction would likely be limited to the minority of recreational fishing vessels that already travel as far from shore as the wind energy facilities. However, it may include recreational vessels traveling farther offshore than is currently typical, and these would be additive to the vessel traffic that already transits within the lease areas. The USCG has no intention of closing offshore wind farms to vessel traffic.	The Proposed Action would include 102 potential new structures (100 WTGs and 2 ESPs) that could act as artificial reefs. Due to the Vineyard Wind 1 Project's relative proximity to Martha's Vineyard, Nantucket, and Nantucket Sound, it is predicted that the WTGs would attract recreational fishermen, on both private and chartered vessels. This would introduce additional vessels to the area, some of which may not be skilled mariners whose vessels may not be seaworthy for that far offshore and may have difficulty navigating safely. This would have localized, long-term, continuous, **minor** impacts on navigation and vessel traffic.	The impacts on navigation and vessel traffic from this sub-IPF under the Proposed Action would include increased recreational fishing vessel traffic in the proposed Project area. This could lead to increased congestion and navigational complexity within the wind farm, which, could result in damage to vessels, injury to crews, engagement of USCG SAR, and vessel fuel spills. This would have localized, long-term continuous, **minor** impacts on navigation and vessel traffic. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale and adjusted to consider likelihood of visitation by recreational vessels due to relative proximity to shore. Cumulative impacts on navigation and vessel traffic from this sub-IPF would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, with the extent of coverage increasing as additional offshore wind projects are placed in service, and would thus be long-term, continuous, regional, and **minor**.
Presence of structures: Habitat conversion	Equipment in the ocean can create a substrate for mollusks to attach to, and fish eggs to settle near. This can create a reef-like habitat and benefit structure-oriented species on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	Offshore wind energy facilities could create foraging opportunities for seals and small odontocetes, possibly attracting private or commercial recreational sightseeing vessels. As a result, the presence of new habitat could increase navigational complexity as each new facility is built, completed, and matures. New structures would be added intermittently over an assumed 6- to 10-year period and could benefit structure-oriented species as long as the structures remain.	The Proposed Action could create foraging opportunities for seals, small odontocetes, and sea turtles, possibly attracting private or commercial recreational sightseeing vessels. As a result, the presence of new habitat could increase navigational complexity as each new facility is built, completed, and matures. This would have long-term, **negligible** impacts on navigation and vessel traffic.	The impacts on navigation and vessel traffic from this sub-IPF under the Proposed Action would include increased recreational fishing vessel traffic in the proposed Project area. This could lead to increased congestion and navigational complexity within the wind farm, which could result in damage to vessels, injury to crews, engagement of USCG SAR, and vessel fuel spills. This would have localized, long-term, continuous, **negligible** impacts on navigation and vessel traffic. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Cumulative impacts on navigation and vessel traffic from this sub-IPF would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, with the extent of coverage increasing as additional offshore wind projects are placed in service, and would thus be regional, long-term, continuous, and **negligible**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Migration disturbances	Noise-producing activities, such as pile driving and vessel traffic, may interfere and adversely affect marine mammals during foraging, orientation, migration, response to predators, social interactions, or other activities. Marine mammals may also be sensitive to changes in magnetic field levels. The presence of structures and operation noise could cause mammals to avoid areas.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	Wind energy projects could encourage cetaceans to migrate outside normal patterns to avoid WTGs and ESPs. These revised routes might lead the cetaceans to locations where they are more likely to interact with vessels, leading to a larger probability of vessel strike. The anticipated 1 nautical mile spacing between structures would be sufficient to allow vessels unimpeded access within wind farms and between wind farm projects. Additional or more compressed vessel traffic within the WDA may increase the risk of marine mammal or turtle vessel strikes. New structures would be added intermittently over an assumed 6- to 10-year period and could increase this risk long as the structures remain.	The anticipated 1 nautical mile spacing between structures would be sufficient to allow unimpeded access within wind farms. Additional or more compressed vessel traffic within the WDA may increase the risk of marine mammal or turtle vessel strikes. New structures would be added intermittently over an assumed 6- to 10-year period and could increase this risk as long as the structures remain. This would have long-term, **minor** impacts on navigation and vessel traffic.	The impacts on navigation and vessel traffic from this sub-IPF under the Proposed Action would be due to the emplacement of structures encouraging cetaceans to migrate outside normal patterns to avoid WTGs and ESPs in the proposed Project area. This could lead to increased risk of marine mammal or turtle vessel strikes within the wind farm, which could result in damage to vessels, injury to crews, engagement of USCG SAR, and vessel fuel spills. This would have localized, long-term, continuous, **minor** impacts on navigation and vessel traffic. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Cumulative impacts on navigation and vessel traffic from this sub-IPF would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, with the extent of coverage increasing as additional offshore wind projects are placed in service. Additionally, as the Proposed Action layout is a differing layout than the one in the cumulative scenario (an east to west 1 x 1 nautical mile aligned grid), there would be increased navigational complexity in moving through the differing adjacent layouts. Cumulatively, impacts on navigation and vessel traffic under this sub-IPF would be regional, long-term, continuous, and **moderate**.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions. When multiple vessels need to navigate around a structure, then navigation is made more complex, as the vessels need to avoid both the structure and each other.	Absent other information, and because total vessel transits in the area have remained relatively stable since 2010, BOEM does not anticipate vessel traffic to greatly increase over the next 30 years. Even with increased port visits by deep draft vessels, this is still a relatively small adjustment when considering the whole of New England vessel traffic. The presence of navigation hazards is expected to continue at or near current levels.	In addition to avoiding each other, vessels would need to avoid all WTGs and ESPs contemplated in the cumulative scenario (up to 955 WTGs, and 20 ESPs). Vessel bridge viewfields would become more cluttered, requiring vessel operators to increase their vigilance and/or rely more heavily on technological aids to support safe navigation. Depending on the individual layout of each project, wind energy projects would increase navigational complexity, including potential compression of vessel traffic both outside of and within wind development areas, and potential difficulty seeing other vessels due to a cluttered view field. Nautical mile grid layouts that do not align with adjacent projects would further increase navigation complexity. Impacts would increase as each facility is built and completed starting in 2021 and continuing through 2030.	The Proposed Action includes a gridded layout with up to 100 WTG and 2 ESP locations. The gridded layout increases predictability, allowing vessels to more easily plan their movements. The yellow foundation color and the marking of turbines on nautical charts means that operators would be more easily able to discern stationary WTGs/ESPs from other vessels, whether stationary or moving. However, there is the likelihood that the lanes set by the WTGs/ESPs would force vessels into tighter passing scenarios than they would have experienced operating normally in open waters, requiring operators to maintain a higher level of alertness when transiting within or near the WDA, which could lead to increased crew fatigue. The layout of the Proposed Action (0.75-nautical mile spacing, with northeast-southwest and northwest-southeast rows and columns of WTGs) could complicate SAR activities and lead to abandoned SAR missions and resultant increased fatalities. This would have would have localized, long-term, continuous, **moderate** impacts on navigation and vessel traffic.	The impacts on navigation and vessel traffic from this sub-IPF under the Proposed Action would include more restrictive vessel movement in the proposed Project area, as it previously was open ocean. This would lead to increased congestion and navigational complexity within the wind farm, which could result in crew fatigue, damage to vessels, injury to crews, engagement of USCG SAR, and vessel fuel spills. However, the layout of the Proposed Action (0.75-nautical mile spacing, with northeast-southwest and northwest-southeast rows and columns of WTGs) could complicate SAR activities and lead to abandoned SAR missions and resultant increased fatalities. This would have localized, long-term, continuous, **moderate** impacts on navigation and vessel traffic. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Cumulative impacts on navigation and vessel traffic from this sub-IPF would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, with the extent of coverage increasing as additional offshore wind projects are placed in service. Additionally, as the Proposed Action layout is a differing layout than the one in the cumulative scenario (an east to west 1 x 1 nautical mile aligned grid), there would be increased navigational complexity in moving through the differing adjacent layouts. Cumulatively, impacts on navigation and vessel traffic under this sub-IPF would be regional, long-term, continuous, and **major**.
Presence of structures: Space use conflicts	Currently, the offshore area is occupied by marine trade, stationary and mobile fishing, and survey activities. Some deep draft and tug/towing vessels transit between the Narragansett/Buzzards Bay TSSs precautionary area, and points north/east by way of the Nantucket-Ambrose Fairway can cross through the southern portion of the Massachusetts and Rhode Island lease areas, particularly through OCS-A 0500 and 0501.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.	Offshore wind energy projects would add potential structures, including up to 955 WTGs and 20 ESPs. Fishing vessels may have difficulty conducting their exercises and typical activities through these areas. Fixed gear fisheries may have difficulty placing their pots in locations that avoid active fishing or mobile gear vessels. Nautical mile grid layouts that do not align with adjacent projects would further increase navigation complexity. The existing deep draft and tug/towing vessels that can cross through the lease areas would need to adjust their course farther west and south to avoid structures, potentially adding congestion or choke points to the Nantucket-Ambrose Fairway due south of the precautionary area. Impacts would increase as each facility is built and completed starting in 2021 and continuing through 2030.	The Proposed Action's WTGs and ESPs could affect established sailboat races, tour boat routes, for-hire recreational boating and fishing, and commercial fishing locations and techniques. Space use conflicts could result in reduced commercial fishing effort and survey vessels unable to complete their mission with existing methodologies, meaning that the species population estimates could have increased uncertainty. NOAA has indicated that survey vessels may have difficulty maneuvering within the project area. The layout of the Proposed Action (0.75-nautical mile spacing, with northeast-southwest and northwest-southeast rows and columns of WTGs) could complicate SAR activities and lead to abandoned SAR missions and resultant increased fatalities. This would have would have localized, long-term, continuous, **moderate** impacts on navigation and vessel traffic.	The impacts on navigation and vessel traffic from this sub-IPF under the Proposed Action would include space use conflicts and more restricted vessel movement in the proposed Project area, as it previously was open ocean. This would lead to increased congestion and navigational complexity within the wind farm, which could result in crew fatigue, damage to vessels and fishing gear, injury to crews, engagement of USCG SAR, and vessel fuel spills. However, the layout of the Proposed Action (0.75-nautical mile spacing, with northeast-southwest and northwest-southeast rows and columns of WTGs) could complicate SAR activities and lead to abandoned SAR missions and resultant increased fatalities. This would have localized, long-term, continuous, **moderate** impacts on navigation and vessel traffic. Ongoing activities and future non-offshore wind activities would not contribute to this sub-IPF. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Cumulative impacts on navigation and vessel traffic from this sub-IPF would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, with the extent of coverage increasing as additional offshore wind projects are placed in service. Additionally, as the Proposed Action layout is a differing layout than the one in the cumulative scenario (an east to west 1 x 1 nautical mile aligned grid), there would be increased navigational complexity in moving through the differing adjacent layouts. Cumulatively, impacts on navigation and vessel traffic under this sub-IPF would be regional, long-term, continuous, and **major**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Transmission cable infrastructure	See IPF for Anchoring.	See IPF for Anchoring.	See IPF for Anchoring.	See IPF for Anchoring.	See IPF for Anchoring.
New cable emplacement/ maintenance	Within the geographic analysis area for navigation and vessel traffic, existing cables may require access for maintenance activities. Infrequent cable maintenance activities may cause temporary increases in vessel traffic and navigational complexity. There are currently six existing power cables in the geographic analysis area for navigation and vessel traffic. Refer to Appendix A for details.	The FCC has two pending submarine tele-communication cable applications in the North Atlantic. Future new cables, perhaps including those connecting Martha's Vineyard and/or Nantucket to the mainland, would cause temporary increases in vessel traffic during installation or maintenance, resulting in infrequent, localized, short-term impacts over the next 30 years. Care would need to be taken by vessels that are crossing the cable routes during these activities.	Cable maintenance would increase vessel traffic, and would specifically add slower-moving vessel traffic above cable routes. Vessels not associated with wind energy projects would need to exercise caution when crossing the cable routes during maintenance and installation activities.	Non-Project vessels operating in the waters between the ports used by Vineyard Wind and the WDA would be able to avoid Vineyard Wind vessels, components, and access restrictions though small, routine adjustments to navigation. For the OECC, non-Project vessels required to travel a more restricted (narrow) lane near the OECC could potentially experience greater delays waiting for cable-laying vessels to pass. Installation or maintenance would have localized, short-term, intermittent, **minor** impacts on navigation and vessel traffic in general, and **moderate** impacts in Lewis Bay if the New Hampshire Avenue cable landing site is selected.	The impacts on navigation and vessel traffic from this IPF under the Proposed Action would include more restricted vessel movement in the proposed Project area during construction and cable maintenance activities. This would lead to increased congestion and navigational complexity within the wind farm, which could result in crew fatigue, damage to vessels and fishing gear, injury to crews, engagement of USCG SAR, and vessel fuel spills. The space use conflicts for fishing could result in reduced commercial catch within the project area. This would have localized, short-term, intermittent, **minor** impacts on navigation and vessel traffic in general, and **moderate** impacts in Lewis Bay if the New Hampshire Avenue cable landing site is selected. Ongoing activities and future non-offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Cumulative impacts on navigation and vessel traffic from this IPF would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, with the extent of coverage increasing as additional offshore wind projects are placed in service, and adjusted to consider the cable-array layout differences and the difficulty of moving through more complex layouts, as well as differing adjacent layouts. Cumulatively, impacts on navigation and vessel traffic under this IPF from installation would be localized, short-term, intermittent, **minor** impact on navigation and vessel traffic, except for **moderate** impacts in Lewis Bay if the New Hampshire Avenue cable landing site is selected. The cumulative impacts of cable maintenance during operation would be localized, long-term, intermittent, and **negligible**.
Traffic: Aircraft	USCG SAR helicopters are the main aircraft that may be flying at low enough heights to risk interaction with WTGs. USCG SAR aircraft need to fly low enough that they can spot objects in the water.	SAR operations could be expected to increase with any increase in vessel traffic. However, as vessel traffic volume is not expected to increase appreciably, neither should SAR operations. DEIS Section 3.4.5.3 provides a discussion of navigation impacts on fishing vessel traffic.	USCG SAR aircraft need to fly low enough that they can spot objects in the water during days of potentially low visibility, typically lower than the height of the WTGs likely to be installed as part of the cumulative projects. As a result, SAR aircraft (specifically helicopters) would need to fly between proposed WTGs to reach the desired altitude. The Draft MARIPARS report stated that WTGs with 1-nautical-mile spacing and north-south/east-west orientation would provide the USCG with adequate SAR access (north-to-south travel) (USCG 2020). However, SAR pilots would require training on flying through arrays, and may be less comfortable with such maneuvers in poor conditions than over open waters. This, combined with the increased likelihood of vessel allision and collision, could lead to more incidents requiring SAR activity, combined with fewer successful rescues. This concern notwithstanding, the presence of WTGs and ESPs could provide refuge for incident victims, and marking of individual WTGs could facilitate location and rescue by USCG.	Similar impacts to those described for future offshore wind activities (limitations on SAR altitudes and routes). The layout of the Proposed Action would differ from the assumed 1 x 1 nautical mile, east-west/north-south layout of other adjacent offshore wind projects. This would have localized, long-term, continuous, **minor** impacts on aircraft navigation and vessel traffic.	The impacts on navigation and vessel traffic from this sub-IPF under the Proposed Action would include more restricted vessel movement to boaters and low-flying aircraft in the proposed Project area and an increased likelihood of vessel allusion, which may result in more incidents and fewer successful rescues. This would have would have localized, long-term, continuous, **minor** impacts on aircraft navigation and vessel traffic. Ongoing activities and future non-offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Future offshore wind activities would have similar contributions as the Proposed Action, but on a larger scale. Cumulative impacts on navigation and vessel traffic from this sub-IPF would be similar to those described for the Proposed Action, but would occur across the RI and MA Lease Areas, with the extent of coverage increasing as additional offshore wind projects are placed in service, and adjusted to consider the layout differences and the difficulty of moving through more complex layouts, as well as differing adjacent layouts. Cumulatively, impacts on navigation and vessel traffic under this sub-IPF would be localized, long-term, continuous, **moderate** impacts on navigation and vessel traffic.
Traffic: Vessels	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.
Traffic: Vessels, collisions	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.

AIS = Automatic Identification System; BOEM = Bureau of Ocean Energy Management; COP = Construction and Operations Plan; ESP = electrical service platform; FCC = Federal Communications Commission; IPF = impact-producing factors; km^2 = square kilometers; MA = Massachusetts; MARIPARS = Massachusetts and Rhode Island Port Access Route Study; MCT = Marine Commerce Terminal; NOAA = National Oceanic and Atmospheric Administration; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor(s); RI = Rhode Island; SAR = search and rescue; TSS = traffic separation scheme; USCG = U.S. Coast Guard; WDA = Wind Development Area; WTG = wind turbine generator

Table 3.14-1: Summary of Activities and the Associated Impact-Producing Factors for Other Uses

Military and National Security Uses, Baseline Conditions: The geographic analysis area includes military and national security entities' use of airspace, surface, and submarine areas. Generally, an area roughly bounded by Montauk, New York; Providence, Rhode Island; and Provincetown, Massachusetts, and within a 10-mile (16.1-kilometer) buffer from wind lease areas in the MA Lease Area. The United States Navy (Navy), the USCG, and other military and national security entities have numerous facilities in the region (Draft EIS Figure 3.4.8-1). Major onshore regional facilities include Naval Station Newport, the Naval Submarine Base New London, the Northeast Range Complex/Narragansett Bay Operation Area, Joint Base Cape Cod, and numerous USCG stations (Epsilon 2018a). Onshore and offshore military and national security use areas may have designated surface and subsurface boundaries and special use airspace.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Allisions	Existing stationary facilities that present allision risks include the five offshore wind turbines associated with Block Island Wind Farm, dock facilities, meteorological buoys associated with offshore wind lease areas, and other offshore or shoreline-based structures.	No additional non-offshore wind stationary structures were identified within the geographic analysis area. Stationary structures such as private or commercial docks may be added close to the shoreline.	Allision risks would be increased around the 775 WTGs and 20 ESPs during project operations and near lift vessels used during construction. Military and national security vessels more likely to allide with stationary structures would be smaller vessels moving within and near wind installations for SAR operations or other non-typical activities. Deep-draft military and national security vessels near traffic separation schemes or port entrances could potentially lose power and allide with a nearby WTG. Risks would increase incrementally between 2021 and 2030 as additional offshore wind facilities are built within the RI and MA Lease Areas. All structures would be lighted according to USCG and BOEM requirements. Allision risks would be mitigated by WTG spacing at 1 x 1 nautical mile apart. Risk would incrementally decrease as projects are decommissioned and structures are removed.	The addition of up to 57 WTGs and two ESPs to the WDA would increase the risk of allisions for military vessels for 30 years during project operations. During construction, stationary lift vessels within the WDA would also increase allision risk. Military traffic within the WDA is relatively low, and military vessels are not anticipated to navigate outside navigation channels unless necessary for SAR operations and non-typical activities. The Department of Defense concluded that the Proposed Action would have minor but acceptable impacts on their operations; however, this determination doesn't include USCG's activities such as SAR. Allision risks would be mitigated by WTG spacing at 1 x 1 nautical mile apart. Vineyard Wind would coordinate with military and national security interests to minimize impacts during construction, operations, and decommissioning. Allision risk would be eliminated after decommissioning when structures are removed. Overall, presence of stationary structures would cause localized, long-term, **minor** to **moderate** impacts from allision risk.	Section 3.13 discusses navigation and vessel traffic. The impacts on military and national security uses from this sub-IPF under the Proposed Action would include increased allision risk of within the WDA by adding up to 59 stationary structures (57 WTGs and 2 ESPs) for 30 years during operations, and by use of stationary lift vessels within the WDA during construction. Allision risks would be mitigated by spacing the WTGs at 1 x 1 nautical mile apart, by implementing navigational hazard marking as required by BOEM and the USCG, and by Vineyard Wind coordinating with military and national security interests throughout the life of the Proposed Action. Overall, presence of stationary structures from the Proposed Action would cause localized, long-term, **minor** to **moderate** impacts from allision risk. Stationary structures associated with ongoing activities and future non-offshore wind activities that increase allision risks are widely dispersed in the open ocean within the geographic analysis area, and limited to the five offshore wind turbines associated with the Block Island Wind Farm, deployed meteorological buoys associated with the offshore wind site assessment activities, and shoreline developments such as docks. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but more extensive with up to 775 WTGs and 20 ESPs proposed to be constructed within the RI and MA Lease Areas before 2030. Cumulatively, the impacts on military and national security uses from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be localized, long-term, and **minor** to **moderate**.
Presence of structures: Fish aggregation	Existing stationary facilities that act as FADs include offshore wind turbines associated with Block Island Wind Farm.	No future non-offshore wind additional stationary structures that would act as FADs were identified within the geographic analysis area.	WTGs and ESPs in the leased areas could create an artificial reef effect, attracting species of interest to recreational fishing or sightseeing, which could increase demand for USCG SAR operations near the WTGs. Increased risk of conflict or collision risks for military and national security vessels would be *de minimis,* because military vessels are not anticipated to transit outside navigation channels unless necessary for SAR operations or other non-typical activities. Risk would gradually increase between 2021 and 2030 as stationary structures are installed across the RI and MA Lease Areas, and recreational fishing vessels begin to access the development area.	Construction of the Proposed Action would add 57 WTGs and one to two ESPs that could create an artificial reef effect, attracting species of interest to recreational fishing or sightseeing within the WDA, potentially causing conflict or collision risks for military and national security vessels and increased demand for SAR operations. Military traffic within the WDA is relatively low, and military vessels are not anticipated to navigate outside navigation channels unless necessary for SAR operations. Risk would increase during operations when stationary structures are installed and recreational fishing vessels can access the development area. Overall, the reef effect of structures within the WDA would have localized, long-term, **minor** impacts due to allision and collision risk.	Section 3.13 discusses navigation and vessel traffic. Impacts on military and national security uses from this sub-IPF under the Proposed Action would include increased risks of conflicts between military and national security and recreational fishing vessels, and increased demand for SAR operations due to increased recreational fishing within the WDA. The Proposed Action's addition of 59 stationary structures could attract additional recreational fishing boats to the WDA, but conflicts with military vessels would be limited because military vessels are not anticipated to navigate outside navigation channels unless necessary for SAR operations. Overall, the reef effects of the Proposed Action's structures would have localized, long-term, **minor** impacts on military and national security vessels. Stationary structures associated with ongoing and future non-offshore wind activities that could generate reef effects are limited to the five WTGs associated with the Block Island Wind Farm, and shoreline developments such as docks. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but more extensive with up to 795 structures proposed for construction within the RI and MA Lease Areas before 2030. Cumulatively, the impacts on military and national security uses from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be localized, long-term, and **minor**.
Presence of structures: Navigation hazard	Existing stationary facilities within the geographic analysis area that present navigational hazards include the five WTGs in the Block Island Wind Farm, onshore wind turbines, communication towers, dock facilities, and other onshore and offshore commercial, industrial, and residential structures.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers and onshore commercial, industrial, and residential developments.	Addition of up to 775 WTGs with maximum blade tip height of up to 853 feet (260 meters) AMSL and 20 ESPs to RI and MA Lease Areas between 2021 and 2030 would incrementally change navigational patterns and increase navigational complexity for vessels and aircraft operating in the region around offshore wind projects. Use of stationary lift vessels in the lease areas, and cranes at port locations during construction would further increase navigational complexity in localized areas. Increased navigational complexity could increase the risk of collisions and allisions for military and national security vessels or aircraft. It is assumed that offshore wind operators would implement a strict operational protocol with the USCG that requires the WTGs to stop rotating within a specified time to mitigate impacts to SAR aircraft operating in the leased areas. Structures would be visible on military and national security vessel and aircraft radar. Mitigation measures include marking navigational hazards and coordinating with relevant agencies during the COP development process. The FAA would invite the Department of Defense and the Department of Homeland Security (which includes the USCG) to review and comment on	Addition of 57 WTGs with maximum blade tip height of up to 837 feet (255 meters) AMSL and up to two ESPs within the WDA, and use of stationary lift vessels within the WDA and cranes in ports during construction would increase local navigational complexity and change navigational patterns for vessels and aircraft operating in the area around the WDA. This would increase the risk of collisions and allisions for military and national security vessels or aircraft. Structures would be marked as a navigational hazard per FAA, BOEM, and USCG requirements. The WTGs would be visible on radar systems of low-flying military and national security aircraft. As part of the proposed Project, Vineyard Wind would implement a strict operational protocol with the USCG that requires the WTGs to stop rotating within a specified time to mitigate impacts to SAR aircraft operating in the WDA. Nonetheless, the Proposed Action's structures and layout (i.e., lacking 1 x 1 nautical mile spacing and not aligned in east-west rows and north-south columns) could make it more difficult for SAR aircraft to perform operations in the lease area, leading to less effective search patterns or earlier abandonment of searches. This could lead to increased loss of life due to maritime incidents. Vineyard Wind's Marine Coordinator would liaise with the Department of Defense and Department of Homeland	Section 3.13 discusses navigation and vessel traffic. Impacts on military and national security uses from this sub-IPF under the Proposed Action would include increased navigational complexity, changed navigational patterns for aircraft and vessels operating in the area around the WDA, increased collision/allision risk within the WDA, and increased difficulty in completing SAR missions within the WDA (potentially leading to increased fatalities from maritime incidents). Overall, the presence of stationary structures from the Proposed Action within the WDA would cause localized, long-term, **moderate** impacts from increased navigational complexity and associated risks. Additions of stationary structures associated with ongoing and future non-offshore wind activities would continue primarily onshore and would include communications towers, onshore WTGs, and other developments. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but more extensive with up to 775 WTGs and 20 ESPs proposed for construction within the RI and MA Lease Areas before 2030. Cumulatively, the impacts on military and national security uses from this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be localized, long-term, and **major**. All onshore or offshore structures that exceed 200 feet (61 meters) in height and are located in U.S. territorial waters would require submitting Form 7460-1 to the FAA, and military and national security interests would be invited to comment through the FAA review process.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			each Form 7460-1 filing submitted. Navigational hazards would gradually be eliminated when structures are removed during decommissioning.	Security to reduce potential conflicts. The navigational hazard would be gradually eliminated during decommissioning as structures are removed. Overall, presence of stationary structures within the WDA would cause localized, long-term, **moderate** impacts from increased navigational complexity and associated risks.	
Presence of structures: Space use conflicts	Existing stationary facilities within the geographic analysis area that present a navigational hazard include the five WTGs in the Block Island Wind Farm, onshore wind turbines, communication towers, dock facilities, and other onshore and offshore commercial, industrial, and residential structures.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers and onshore commercial, industrial, and residential developments.	Construction and operation of the project structures—primarily 775 WTGs—would change long-term navigational patterns in and around RI and MA Lease Areas during each project's 30-year operational period, potentially concentrating vessels around the outsides of the leased areas, increasing the risk of collisions among military, national security, and civilian vessels. Offshore wind lease areas overlap in approximately 4% of warning area W-105 A, and could affect military and national operations conducted in the warning area. Space use conflicts would decrease during decommissioning as structures are removed.	Access to portions of the WDA would be restricted during construction, and presence of WTGs would change long-term navigational patterns in and around the WDA during the 30-year operational period. Space use conflicts could occur as military and national security vessels, commercial vessels, and recreational vessels route around project facilities. Military traffic within the WDA is relatively low (four vessels recorded within the WDA between 2016 and 2017). Addition of 57 WTGs within the WDA could affect operations within a very small portion of W-105A. Vineyard Wind's Marine Coordinator would liaise with the military and national security interests to reduce potential conflicts. Risks would be eliminated gradually during decommissioning as stationary structures are removed. The Department of Defense concluded that the Proposed Action would have minor but acceptable impacts on their operations. Overall, presence of stationary structures within the WDA would cause localized, long-term, **minor** impacts from increased space use conflicts.	Impacts on military and national security uses from this sub-IPF under the Proposed Action would include potential space use conflicts between the Proposed Action structures within the WDA–primarily 57 WTGs—and military and national security exercises. Project construction would temporarily restrict access to portions of navigable areas within the WDA, and change long-term navigational patterns in and around the WDA during the 30-year operational period. However, military traffic in the WDA is relatively low. The Proposed Action could affect military operations within warning area W-105A; however, Vineyard Wind would hire a Marine Coordinator for the life of the Proposed Action to liaise with the military and national security interests to reduce potential conflicts. The Department of Defense concluded that the Proposed Action would have minor but acceptable impacts on their operations. Overall, presence of stationary structures from the Proposed Action within the WDA would cause localized, long-term, **minor** impacts from increased space use conflicts. Stationary structures associated with ongoing activities and future non-offshore wind activities would continue to be added, primarily onshore, including communications towers, onshore WTGs, and other developments. Onshore developments could cause additional space use conflicts with onshore military activities. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but increased with up to 775 WTGs and 20 ESPs proposed for construction within the RI and MA Lease Areas before 2030. In addition, as multiple projects are built, changing navigation patterns could concentrate vessels within designated navigation corridors and around the outsides of the RI and MA Lease Areas potentially causing space use conflicts in these areas and increasing the risk of collisions among military and national security vessels, commercial vessels, and recreational vessels. Cumulatively, the impacts on military and national security uses form this sub-IPF associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be localized, long-term, and **minor**.
Presence of structures: Transmission cable infrastructure	Eight existing submarine cables are in the geographic analysis area, including submarine power cables between the mainland and Nantucket and Martha's Vineyard, and two cables that cross the far western side of OCS-A 0487.	Submarine cables would remain in current locations with infrequent maintenance continuing along those cable routes for the foreseeable future.	Construction timeframes for the South Fork Wind Farm cable, the Bay State offshore cable, and future offshore wind farm cables would likely be staggered between 2021 and 2030. Military and national security vessels may need to navigate around construction sites. While projects are operational, transmission cables would be passive structures on the seafloor, and would only potentially affect military and national security operations during infrequent cable maintenance events.	Military and national security vessels may need to navigate around the Proposed Action's temporary construction sites. Cable maintenance activities during the 30-year operational period would be infrequent. Vineyard Wind's Marine Coordinator would liaise with the military and national security interests to reduce potential conflicts. Impacts on military and national security uses would be localized, temporary, and **negligible**.	Impacts on military and national security uses from this sub-IPF under the Proposed Action would include military and national security vessels having to route around cable construction vessels along the cable routes and within the WDA, and during infrequent cable maintenance events. Impacts from construction and operation from the Proposed Action would be localized, temporary, and **negligible** due to the temporary nature of construction along the cable routes, the anticipated rarity of cable maintenance events, and ongoing coordination with military and national security interests. Ongoing activities and future non-offshore wind activities are limited to infrequent maintenance events along existing submarine cables within the geographic analysis area. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but located at the Bay State and South Fork Wind Farm cable routes and at currently unknown cable routes associated with other lease areas offshore of Massachusetts and Rhode Island. Construction of cable routes associated with other wind developments would likely be staggered temporally, further minimizing risk to military operations. Cumulatively, impacts on military and national security from the presence of cables associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be localized, temporary, and **negligible**.
Traffic: Vessels	Current vessel traffic in the region is described in Draft EIS Section 3.4.7. Vessel activities associated with offshore wind in the cumulative lease areas is currently limited to site assessment surveys.	Continued vessel traffic in the region, as described in Draft EIS Section 3.4.7.	See Section 3.13.2. Vessel traffic could cause military and national security to change routes, and could cause congestion and delays in port and within transit routes, particularly during construction (between 2021 and 2030) and decommissioning, when vessel traffic would be highest, particularly if construction periods overlap. Operational traffic would occur at lower, consistent levels over the 30-year operational timeframes for each project. Operational traffic volumes would be small compared to existing civilian vessel traffic in the region.	See Section 3.13.2. Vessel traffic associated with construction and decommissioning of the Proposed Action could cause military and national security vessels to change routes, and could cause congestion and delays in port and within transit routes. Vineyard Wind would coordinate with the Navy and USCG during all phases of the proposed Project to minimize conflicts within the WDA, along transit routes, and within ports. Operational vessel traffic would be similar to existing civilian vessel activity in and near the WDA. Impacts on military and national security from Proposed Action-related vessel traffic would be localized, temporary, and **minor** during construction and decommissioning and **negligible** during operations.	See Section 3.13.2. The Proposed Action's vessel traffic could cause military and national security vessels to change routes or experience congestion and delays in port and within transit routes. Risks under this sub-IPF would be highest during project construction and decommissioning when vessel traffic associated with the Proposed Action would be highest, and risks would be lowest during operations when Proposed Action vessel traffic would be similar to civilian vessel traffic in the area. Impacts from the Proposed Action on military and national security vessels would be localized, temporary, and **minor** during construction and decommissioning, and **negligible** during operations, considering ongoing coordination with military and national security interests. Current levels of vessel traffic are discussed in Section 3.13.1. Vessel traffic from each future offshore wind project would be similar to the Proposed Action, although as many as five projects could be under construction simultaneously in 2022–2023. Operational traffic volumes from each offshore wind project would be small compared to existing civilian vessel traffic in the region. Cumulatively, impacts are most likely to occur during construction and decommissioning timeframes associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities and would be localized, temporary, and **minor**.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Traffic: Vessels, collisions	Current vessel traffic in the region is described in Draft EIS Section 3.4.7. Vessel activities associated with offshore wind in the cumulative lease areas is currently limited to site assessment surveys.	Continued vessel traffic in the region is described in Draft EIS Section 3.4.7.	See the discussion of "Traffic: Vessels" above for a detailed description of vessel traffic from future offshore wind activities. During construction and operation, risks of collisions between military and national security vessels and offshore wind vessels would increase, particularly at port facilities and within transit routes.	See the discussion of "Traffic: Vessels" above for a detailed description of vessel traffic associated with the Proposed Action. Vessel traffic associated the Proposed Action could increase collision risk among project vessels and military and national security vessels during construction and decommissioning. Impacts would be localized, temporary, and **negligible**.	See the discussion of "Traffic: Vessels" above for conclusions regarding vessel traffic. The impacts on military and national security uses from this sub-IPF under the Proposed Action would include increased collision risks. These impacts would occur mostly during construction and decommissioning, and would be localized, temporary, and **negligible**. Similar to the discussion above for the Traffic: Vessels sub-IPF, direct and indirect impacts are most likely to occur during construction and decommissioning associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities, and would be localized, temporary, and **negligible**.

Aviation and Air Traffic, Baseline Conditions: The geographic analysis area includes airspace and airports used by regional air traffic. Generally, an area roughly bounded by Montauk, New York; Providence, Rhode Island; and Provincetown, Massachusetts, and within a 10-mile (16.1-kilometer) buffer from wind lease areas in the RI and MA Lease Areas. Numerous public and private-use airports are in the region. Major airports serving the region include Boston Logan International Airport, approximately 90 miles (145 kilometers) north of the WDA, and T.F. Green Airport in Providence, Rhode Island, approximately 65 miles (105 kilometers) northwest of the WDA. The closest public airports to the WDA are Nantucket Memorial Airport on Nantucket, and Katama Airpark and Martha's Vineyard Airport, both located on Martha's Vineyard. Private airports or airstrips proximate to the proposed Project area are located on Tuckernuck Island and Martha's Vineyard (Trade Wind Airport). Other public and private airports and heliports are located on the mainland. Military air traffic use the area, and government and other private aircraft may occasionally fly over the WDA for data collection and SAR operations.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Navigation hazard	Existing aboveground stationary facilities within the geographic analysis area that present navigational hazards include the five WTGs in the Block Island Wind Farm, onshore wind turbines, communication towers, dock facilities, and other onshore and offshore structures exceeding 200 feet in height.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore development activities are anticipated to continue with additional proposed communications towers.	Addition of 775 WTGs with maximum blade tip heights of up to 853 feet (260 meters) AMSL and stationary construction cranes in ports during construction would incrementally increase navigational complexity and necessitate changes in aircraft navigation patterns in the region around the leased areas offshore of Massachusetts and Rhode Island, increasing collision risks for low-flying aircraft. The WTGs would be visible on low-flying aircraft radar, and would have obstruction marking or lighting pursuant to FAA and BOEM requirements to reduce collision risk. BOEM assumes that all project operators would coordinate with aviation interests during permitting to minimize navigational hazards. Changes to airport flight routes may be required, and would be identified through FAA review or independent studies conducted by the project proponents. Navigational hazards and collision risks would be gradually eliminated during decommissioning as structures are removed.	Addition of 57 WTGs with maximum blade tip heights of up to 837 feet (255 meters) AMSL within the WDA would increase navigational complexity and change aircraft navigational patterns around the WDA, increasing collision risks for low-flying aircraft during the Proposed Action's 30-year operational life. The WTGs would have navigational markings and lighting pursuant to FAA and BOEM requirements, and would be visible on the radar systems of low-flying aircraft. The WTGs could necessitate changes in some designated instrument flight routes for Nantucket Memorial Airport and other airports in the region. These changes would be confirmed during FAA review for the 14 MW WTGs located in U.S. territorial waters. More than 90% of existing air traffic over the WDA occurred at altitudes that would not be affected by the presence of WTGs. Pilots who choose to fly at lower altitudes over open ocean near the WDA would have to alter routes to avoid potential collisions with WTGs. Vineyard Wind's Marine Coordinator would also manage potential airspace conflicts. Navigational hazards and collision risks would be gradually eliminated during decommissioning as structures are removed. Overall impacts on aviation and air traffic would be localized, long-term, and **minor**.	Impacts on aviation and air traffic from this sub-IPF under the Proposed Action would include increased navigational complexity and necessitate changes in aircraft navigation patterns around the WDA. Reasonably foreseeable consequences include increased collision risks for low-flying aircraft due to addition of up to 57 WTGs within the WDA, plus use of cranes in ports during the construction period. The WTGs would be visible on radar systems of low-flying aircraft, and would have obstruction marking and lighting in accordance with FAA and BOEM requirements. Vineyard Wind would coordinate with air traffic interests to address airspace conflicts and changes to designated instrument flight routes at airports in the region, as identified during FAA review. Vineyard Wind's Marine Coordinator would also manage potential airspace conflicts. Impacts on aviation and air traffic are therefore anticipated to be localized, long-term, and **negligible**. Stationary structures associated with ongoing and future non-offshore wind activities would continue to be added, primarily onshore, and would include communications towers, onshore WTGs, and other developments. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but more extensive with up to 775 WTGs with maximum blade tip height of up to 853 feet (260 meters) AMSL proposed for construction within RI and MA Lease Areas by 2030. Onshore or offshore construction projects with structures exceeding 200 feet (61 meters) in height (such as wind turbines and communication towers) and located in U.S. territorial waters are required to conduct FAA reviews or will conduct independent studies through which necessary changes to navigational patterns are identified, resulting in regional, long-term, and **minor** impacts on aviation and air traffic uses.
Presence of structures: Space use conflicts	Existing aboveground stationary facilities within the geographic analysis area that could cause space use conflicts for aircraft include the five WTGs associated with Block Island Wind Farm, onshore wind turbines, communication towers, and other onshore and offshore structures exceeding 200 feet in height.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers.	See the discussion of Presence of structures: Navigation hazard sub-IPF above. Addition of WTGs and construction cranes would necessitate altering aviation navigation patterns near offshore wind facilities. These changes could compress lower-altitude aviation activity into more limited airspace around RI and MA Lease Areas, leading to airspace conflicts or congestion. Open airspace around RI and MA Lease Areas would still be available over the open ocean. Changes to airport flight routes would be identified and implemented through FAA review or independent studies conducted by project proponents. Navigational hazards and collision risks would be gradually eliminated during decommissioning as structures are removed.	See the discussion of Presence of structures: Navigation hazard sub-IPF above. Construction of the Proposed Action would add 57 WTGs with maximum blade tip height of up to 837 feet (255 meters) AMSL to the WDA and would necessitate changes in aircraft navigation patterns at nearby airports, as described above in "Presence of structures: Navigation hazards." These changes could compress lower-altitude aviation activity into more limited airspace around the WDA, leading to airspace conflicts or congestion. Open airspace around RI and MA Lease Areas would still be available over the open ocean. Changes to airport flight routes may be required, and would be identified confirmed through FAA review for the 14 MW turbines located in U.S. territorial waters. Any space use conflicts would be gradually eliminated during decommissioning as structures are removed. Overall impacts on aviation and air traffic from space use conflicts would be localized, long-term, and **negligible**.	See the discussion of Presence of structures: Navigation hazard sub-IPF above. Impacts on aviation and air traffic from this sub-IPF under the Proposed Action could cause airspace conflicts or congestion with low-flying air traffic. Construction of the Proposed Action would require changes to aircraft navigation patterns at nearby airports. Open airspace around the RI and MA Lease Areas would still be available over the open ocean. Changes to airport flight routes would be identified and implemented through FAA review, and impacts on aviation and air traffic would be localized, long-term, and **negligible**. Navigational hazards and collision risks would be gradually eliminated during decommissioning as structures are removed. Stationary structures associated with ongoing and future non-offshore wind activities would continue to be added primarily onshore and may include communications towers, onshore WTGs, and other developments. Impacts from future offshore wind activities would be similar to those of the Proposed Action, but more extensive with up to 795 WTGs with maximum blade tip height of up to 853 feet (260 meters) AMSL proposed to be constructed within RI and MA Lease Areas before 2030. The FAA review process would be used to identify and resolve space use conflicts for all structures exceeding 200 feet in height and located in U.S. territorial waters; potential space use conflicts related to other structures would be identified through independent studies conducted by project proponents. Airspace over open ocean would remain, resulting in regional, long-term, and **minor** impacts on aviation and air traffic.

Cables and Pipelines, Baseline Conditions: The geographic analysis area is within 1 mile (1.6 kilometers) of the OECC and WDA, and other undersea facilities and wind lease areas in RI and MA Lease Areas that could affect future siting or operation of cables and pipelines. The coastal region of Massachusetts and Rhode Island is served by the onshore electrical grid and a network of pipelines. Islands in the region, including Block Island, Martha's Vineyard, and Nantucket, are served by submarine power cables. Several transatlantic cables make landfall near Charlestown, Massachusetts. No offshore pipelines are in the region immediately surrounding the proposed Project.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Allisions and navigation hazards	Structures within and near the geographic analysis area that pose potential allision hazards include the five Block Island Wind Farm WTGs, meteorological buoys associated with offshore wind lease areas, and shoreline developments such as docks, ports, and other commercial, industrial, and residential structures.	Reasonably foreseeable non-offshore wind structures that could affect submarine cables have not been identified in the geographic analysis area.	WTGs, ESPs, and use of stationary lift vessels during construction could pose allision risks to vessels conducting maintenance activities on the two submarine cables that cross OCS-A 0487 (Sunrise Wind). Such risk would be rare due to infrequent submarine cable maintenance. Risk would increase during construction as structures are built out, be consistent during operations, and decrease to zero during decommissioning as structures are removed. Allision risks would be mitigated by required FAA, BOEM, and USCG navigational hazard marking, and by the 1 x 1 nautical mile spacing throughout the leased areas.	No existing submarine cables are within the WDA. The Proposed Action's 57 WTGs and two ESPs are not likely to pose an allision risk to vessels conducting maintenance activities at existing submarine cables near the WDA. Such vessels could route around or through the WDA, and impacts would be rare due to infrequent submarine cable maintenance. Risk would increase during construction as structures are built out, be consistent during operations, and decrease to zero through decommissioning as structures are removed. Impacts would be localized, temporary, and **negligible**.	Impacts on cables from this sub-IPF under the Proposed Action would include increased allision risk for vessels conducting maintenance activities at existing submarine cables as they transit through or near the WDA. Such impacts would be rare due to infrequent submarine cable maintenance, mitigated by required FAA, BOEM, and USCG navigational hazard marking, and mitigated by the 1 x 1 nautical mile spacing throughout the leased areas. Impacts from the Proposed Action would be localized, temporary, and **negligible**. Existing structures that pose allision risks are limited within the open ocean geographic analysis area. Increased allision risks to vessels conducting cable maintenance would be caused mainly by addition of WTGs and ESPs associated with future offshore wind activities in RI and MA Lease Areas. Cable maintenance vessels transiting through the leased areas and vessels conducting maintenance on the two submarine cables that cross OCS-A 0487 would be at risk of allisions, but risk would be mitigated by navigational hazard marking and implementation of the 1 x 1 nautical mile spacing throughout the leased areas. Cumulatively, impacts on vessels conducting cable maintenance in the geographic analysis area associated with the Proposed Action when combined with past, present, and reasonably foreseeable activities would be localized, temporary during rare cable maintenance events, and **negligible**.
Presence of structures: Space use conflicts	Two submarine cables cross the far western portion of OCS-A 0487. These cables are associated with a larger network of submarine cables that make landfall near Charlestown, Massachusetts.	Reasonably foreseeable non-offshore wind structures have not been identified in the geographic analysis area.	Presence of WTGs, inter-array cables, and inter-link cables could preclude additional submarine cable development through the wind development areas and require cables to route around the leased areas. Cable crossings could be accomplished using standard protection techniques. Impacts on submarine cables would be eliminated during decommissioning of offshore wind developments if export cables associated with those projects are removed.	No existing submarine cables are within the WDA. Construction of the Proposed Action could preclude future submarine cable development through the WDA, forcing future submarine cables, including future offshore wind export cables, to be routed around the WDA. Space use conflicts could be eliminated during decommissioning if structures are removed. Cables can be protected by standard techniques during construction, operations, and decommissioning; therefore, impacts would be localized, long-term, and **negligible**.	Under this sub-IPF, construction of the Proposed Action would preclude future submarine cables within the WDA, due to presence of WTGs and inter-array cabling. Submarine cables, including future offshore wind export cables, would need to be routed around the Proposed Action. Cables can be protected by standard techniques during construction, operations, and decommissioning; therefore, impacts from the Proposed Action would be localized, long-term, and **negligible**. Ongoing maintenance of existing submarine cables in the western portion of OCS-A 0487 would continue into the future, and future offshore wind activities would restrict future cable placement within developed areas of RI and MA Lease Areas. Reasonably foreseeable impacts would be the same as those for the Proposed Action, but more extensive. Because cables can be protected by standard techniques during construction, operations, and decommissioning, impacts would be localized, long-term, and **negligible**. Implementation of Anbaric's Southern New England OceanGrid Project could consolidate cables associated with offshore wind projects around RI and MA Lease Areas, reducing the potential for space- use conflicts between offshore wind export cables and existing submarine cables; however, this project is not considered reasonably foreseeable.
Presence of structures: Transmission cable infrastructure	Two submarine cables cross the far western portion of OCS-A 0487. These cables are associated with a larger network of submarine cables that make landfall near Charlestown, Massachusetts.	Reasonably foreseeable non-offshore wind structures have not been identified in the geographic analysis area.	Cables associated with future offshore wind developments would have to consider the location of existing cables during routing, including the South Fork Wind Farm cable and the Bay State offshore cable. Export cables associated with offshore wind developments would be able to cross existing cables using standard protection techniques. Impacts during project operations would be infrequent and limited to times when work at the cable crossings would be required.	The Proposed Action would use standard techniques during construction, operations, and maintenance to prevent damage to the National Grid Hyannis Port–Jetties Beach submarine power cable, if the New Hampshire Avenue landfall site is selected. Impacts during Project operations would be infrequent and limited to times when work at the cable crossings would be required. Impacts would decrease to zero after decommissioning if cables are removed. Cables can be protected by standard techniques during construction, operations, and decommissioning; therefore, impacts would be localized, long-term, and **negligible**.	The Proposed Action under this sub-IPF is unlikely to affect existing submarine cables, because standard techniques can be used to protect both cables during construction, maintenance, and decommissioning where crossings occur. Ongoing activities and future non-offshore wind activities are limited to infrequent maintenance events along existing submarine cables within the geographic analysis area. Construction, operations, and decommissioning of the Proposed Action's export cables are not likely to affect existing submarine cables, because standard techniques can be used to protect both cables where crossings occur. As a result, the Proposed Action would have localized, long-term, **negligible** impacts on transmission cable infrastructure. Existing submarine cables and infrequent maintenance at those cables would continue into the future. Future offshore wind activities would add at least one export cable for each project area. Impacts would be the same as those for the Proposed Action, but over a larger geographic area, affecting additional existing submarine cables. Because cables can be protected by standard techniques during construction, operations, and decommissioning, direct and indirect impacts on transmission cables from the Proposed Action when combined with future offshore wind projects, impacts would be localized, long-term, and **negligible**.

Radar Systems, Baseline Conditions: The geographic analysis area includes airspace used by regional air traffic. Generally, the geographic analysis area is an area roughly bounded by Montauk, New York; Providence, Rhode Island; and Provincetown, Massachusetts, and within a 10-mile (16.1-kilometer) buffer from wind lease areas in RI and MA Lease Areas. Commercial air traffic control radar systems, national defense radar systems, and weather radar systems operate in the proposed Project region. National defense radar systems operating within the proposed Project region include the Precision Acquisition Vehicle Entry/Phased Array Warning System installation at Joint Base Cape Cod. Regional navigation radar systems typically include Air Route Traffic Control Centers and Terminal Radar Approach Control Centers. The closest such facilities are near Boston, more than 90 miles (145 kilometers) from the WDA. The nearest Next-Generation Radar weather system radar is approximately 60 miles (97 kilometers) north of the proposed Project. The FAA operates a Terminal Doppler Weather Radar installation at the Boston Logan International Airport approximately 90 miles (145 kilometers) north of the WDA.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Navigation hazards	Wind developments in the direct line-of-sight with, or extremely close to, radar systems can cause clutter and interference. Existing wind developments in the area include scattered onshore wind turbines, and five WTGs in the Block Island Wind Farm.	Reasonably foreseeable non-offshore wind structures proposed for construction in the lease areas that could affect radar systems have not been identified.	WTGs installed in RI and MA Lease Areas between 2021 and 2030 would be located a sufficient distance from NOAA NEXRAD weather radar systems such that radar interference and mitigation would not be anticipated. The FAA would evaluate potential impacts on aeronautical and military radar systems, as well as mitigation measures when project operators file Form 7460-1 for each WTG that exceeds 200 feet AMSL in height and is located in U.S. territorial waters. For WTGs not located in U.S. territorial waters, it is assumed that project	Construction of the Proposed Action would add up to 57 WTGs with maximum blade tip height of up to 837 feet (255 meters) AMSL to the WDA. A U.S. Department of Energy screening tool did not identify any potential conflicts between the Proposed Action and ground-based NEXRAD radars. Overlapping coverage and radar optimization are anticipated to mitigate any impacts on long-range radar systems (Vineyard Wind COP Section 7.9.2.2.6, Volume III; Epsilon 2020). The FAA would evaluate potential impacts on radar systems, as well as mitigation measures for those when Vineyard Wind refiles	Impacts on radar systems from this sub-IPF under the Proposed Action may include impacts on long-range radar systems that could be mitigated by overlapping coverage and radar optimization. No impacts on NOAA NEXRAD weather radar systems are anticipated from development of WTGs in the WDA, due to distance. Impacts to military and civilian radar facilities are not anticipated due to, ongoing coordination conducted by the Marine Coordinator, and FAA or project operator review of impacts on radar systems. Impacts on radar systems from the Proposed Action would be localized, long-term, and **minor**. Previous FAA review will have identified impacts on radar systems from existing structures exceeding 200 feet in height and located in U.S. territorial waters. The FAA would also review future non-offshore wind and offshore wind structures exceeding 200 feet in height and located in U.S. territorial waters, pursuant to filing of Form 7460-1, and specifically for each of the 795 WTGs proposed for construction within the RI and MA Lease Areas located in U.S. territorial waters.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
			proponents would conduct independent analyses. These analysis processes would identify potential impacts and any mitigation measures specific to radar systems for each WTG analyzed.	Form 7460-1 for individual WTGs located in U.S. territorial waters (see the "Aviation and Air Traffic" discussion above). Vineyard Wind's Marine Coordinator would liaise with military, national security, civilian, and private interests for the life of the Proposed Action to reduce potential radar conflicts. Impacts on radar systems from the Proposed Action would be localized, long-term, and **minor**.	For WTGs located outside U.S. territorial waters, it is assumed that project proponents would conduct independent analyses. These processes would identify potential impacts and any mitigation measures specific to radar systems for each WTG and cumulative impacts on radar systems would be localized, long-term, and **minor**.

Scientific Research and Surveys, Baseline Conditions: The geographic analysis area is the same as that provided for Finfish, Invertebrates, and Essential Fish Habitat (Section 3.4.1) and includes the footprint of the Proposed Action, and all reasonably foreseeable projects (as outlined in Appendix A) between Maine and mid-North Carolina. The geographic analysis area is reduced from what was considered in the Draft EIS—which also included areas southward to Florida—to better reflect the locations of scientific research and surveys similar to what is expected to occur within the WDA and OECC route.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent	Future Offshore Wind-related Activities Intensity/Extent	Vineyard Wind 1 Project-related Activities Intensity/Extent	Conclusion
Presence of structures: Navigation hazards	Stationary structures are limited in the open ocean environment of the geographic analysis area, and include met buoys associated with site assessment activities, the five Block Island Wind Farm WTGs, and the two CVOW WTGs. Other lease areas within the geographic analysis area are not yet developed, and are in various stages of permitting.	Reasonably foreseeable non-offshore wind activities would not implement stationary structures within the open ocean environment that would pose navigational hazards and raise the risk of allisions for survey vessels and collisions for survey aircraft.	Construction of future offshore wind facilities would add up to 775 WTGs to the RI and MA Lease Areas and 1,059 WTGs maximum blade tip heights of up to 853 feet (260 meters) AMSL to the geographic analysis rea between 2021 and 2030. Collectively, these developments will prevent continued NMFS scientific research surveys under current vessel capacities and monitoring protocols in the geographic analysis area and may reduce opportunities for other NMFS scientific research studies in the area. Survey operations will be curtailed or eliminated under current vessel capacities and monitoring protocols. The need for survey vessels to navigate around large offshore wind projects to access survey stations would cause a loss of efficiency for surveys conducted outside the wind energy areas by reducing sampling time available with limited sea day allocations for survey vessels. Coordinators of large vessel survey operations or operations deploying mobile survey gear have currently determined activities within offshore wind facilities are not within their safety and operational limits. In addition, changes in required flight altitudes due to proposed turbine height will affect aerial survey design and protocols. BOEM acknowledges that NOAA's Office of Marine and Aviation Operations endorses the restriction of large vessel operations to greater than 1 nautical mile from wind installations due to safety and operational challenges.	Construction of the Proposed Action would add up to 57 WTGs with maximum blade tip heights of up to 837 feet (255 meters) AMSL height to the WDA during the construction period. Presence of structures would pose navigational hazards and prevent sampling within the Vineyard Wind lease area. For Fish and Shellfish Research Programs, the Vineyard Wind lease area alone overlaps strata associated with three different coast-wide Northeast Fisheries Science Center fishery resource monitoring surveys. For the spring and fall multi-species bottom trawl surveys, 6% of the area in one stratum would be within the Vineyard Wind lease area. For the ocean quahog (*Arctica islandica*) survey, 3% of the area in one stratum would be within the lease area. For the Protected Species Research Programs, aerial survey track lines at the altitude used in current cetacean and sea turtle abundance surveys (600 feet AMSL) could not occur in the WDA due to safety concerns. Overall , the Proposed Action is anticipated to have **major** impacts on scientific surveys, potentially leading to indirect impacts on fishery participants and communities (Sections 3.7.2 and 3.11.2), and potential **major** impacts on monitoring and assessment activities associated with recovery and conservation programs for protected species.	Overall , the Proposed Action is anticipated to have **major** impacts on scientific surveys, potentially leading to indirect impacts on fishery participants and communities (Sections 3.7.2 and 3.11.2), and potential major impacts on monitoring and assessment activities associated with recovery and conservation programs for protected species. From a cumulative perspective, the NMFS Northeast Fisheries Science Center will require additional resources to evaluate options and to design and implement survey adaptations to account for offshore wind facilities in their survey study areas. Potential challenges include identification of appropriate sampling protocols and technology, development and establishment of parameters for new statistical survey models, and calibration of new approaches to existing ones in order to continue to sample within areas occupied by turbine foundations and submarine cables. BOEM is committed to working with NOAA toward a long-term solution to account for changes in survey methodologies as a result of offshore wind developments. The cumulative impact scenario for the NMFS scientific surveys presented in this document has not been fully assessed, but preliminary analyses of the effects on survey areal coverage demonstrate substantial impacts on NMFS' ability to continue using current methods to fulfill its mission of precisely and accurately assessing fish and shellfish stocks for the purpose of fisheries management, and assessing protected species for the purpose of protected species management. Changes to existing survey methodologies or disruption to the long-term survey time series of fish and shellfish will have implications for stock assessments by increasing uncertainty in biomass estimates and other parameters used in projecting fishery quotas. Uncertainty in estimating fishery quotas could lead to unintentional underharvest or overharvest of individual fish stocks, which could have both indirect beneficial and adverse impacts on fish stocks, respectively. Based on existing regional Fishery Management Councils' acceptable biological catch control rule processes and risk policies (e.g., 50 CFR §§ 648.20 and 21), increased assessment uncertainty would likely result in lower commercial quotas that may reduce the likelihood of overharvesting and mitigate associated biological impacts on fish stocks. However, such lower quotas would result in lower associated fishing revenue that would vary by species, which could result in indirect impacts on fishing communities. Development of new survey technologies, changes in survey methodologies, and required calibrations may help to mitigate losses in accuracy and precision of current practices due to the impacts of wind development on survey strata. Overall, BOEM anticipates that the Proposed Action, when combined with other past, present, and reasonably foreseeable activities, would have **major** impacts on NMFS' scientific research and surveys and the resulting stock assessments, which could lead to potential beneficial and adverse indirect impacts on fish stocks when management decisions are based on biased or imprecise estimates of stock status (Sections 3.7.2 and 3.11.2 for additional discussion about economics and commercial fisheries).

AMSL = above mean sea level; BOEM = Bureau of Ocean Energy Management; CVOW = Coastal Virginia Offshore Wind; ESP = electrical service platform; FAA = Federal Aviation Administration; FAD = Fish Attracting Device; IPF = impact-producing factor; MA = Massachusetts; met = meteorological; NEXRAD = Next Generation Weather Radar; NMFS = National Marine Fisheries Service; NOAA = National Oceanic and Atmospheric Administration; OECC = Offshore Export Cable Corridor(s); OCS = outer continental shelf; RI = Rhode Island; SAR = search and rescue; USACE = United States Army Corps of Engineer; USCG = United States Coast Guard; WDA = Wind Development Area; WTG = wind turbine generator

B.2. FIGURES

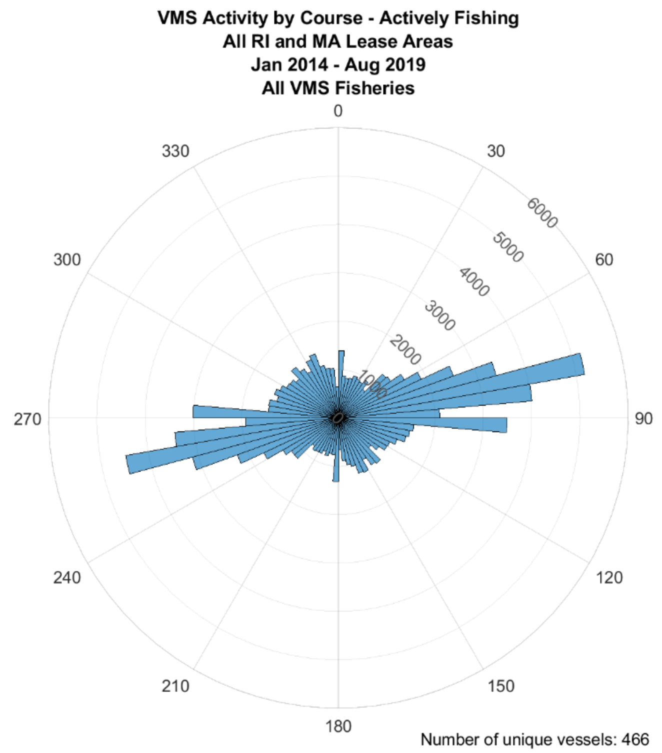

Figure 3.11-1: All VMS Fisheries in RI and MA Lease Areas—Fishing

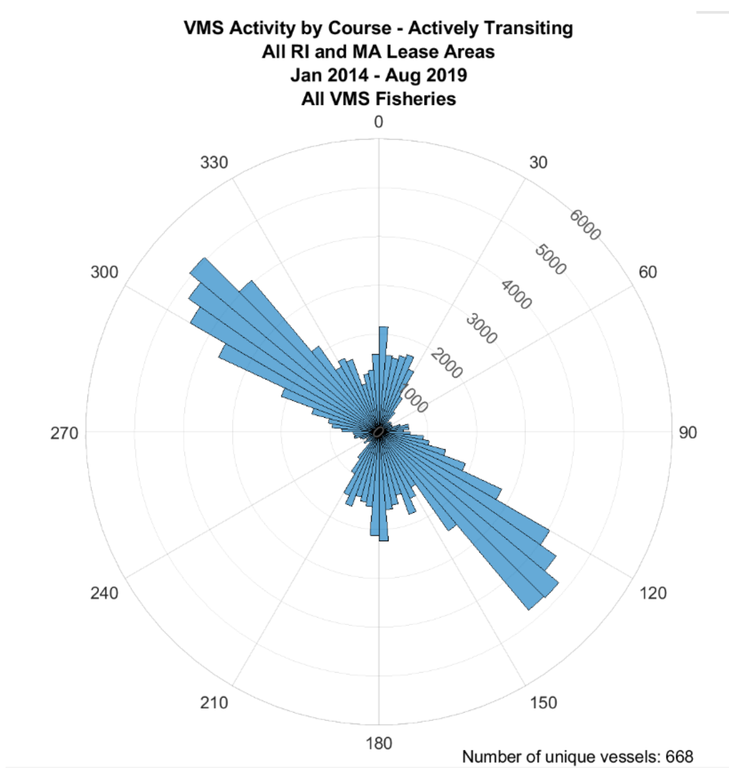

Figure 3.11-2: All VMS Fisheries in RI and MA Lease Areas—Transiting

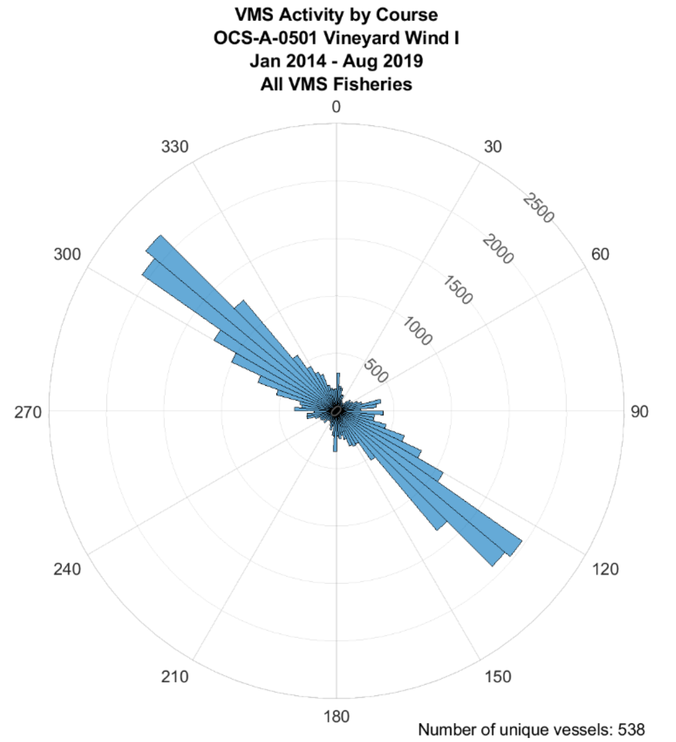

Figure 3.11-3: All VMS Fisheries in Vineyard Wind WDA—Fishing and Transiting

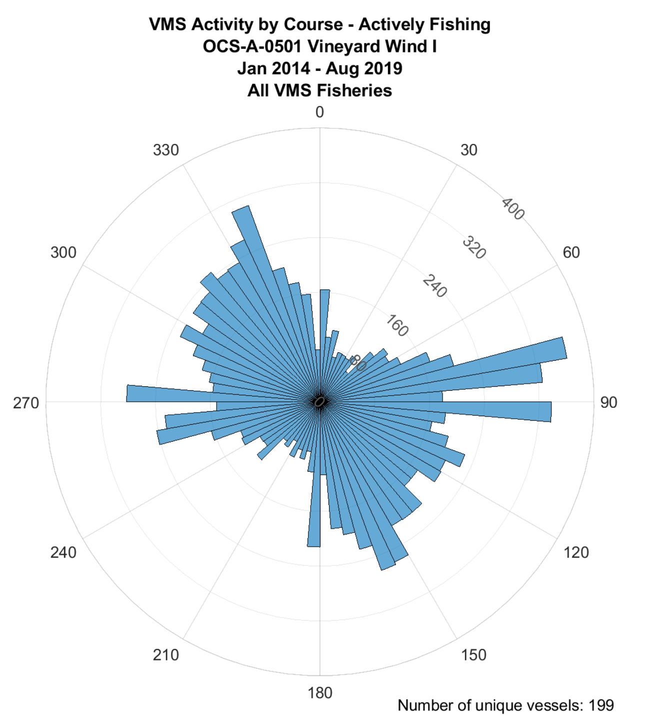

Figure 3.11-4: All VMS Fisheries in Vineyard Wind WDA—Fishing

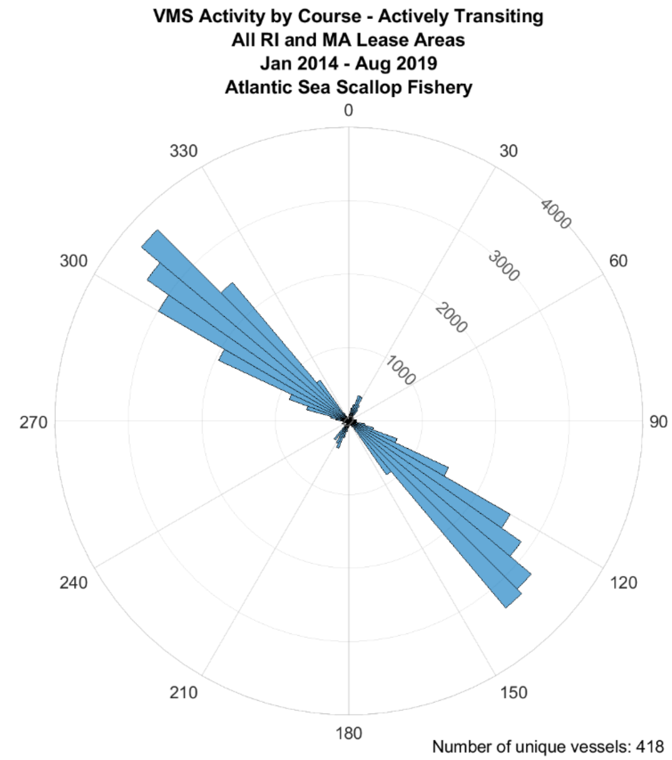

Figure 3.11-5: Sea Scallop Fishery in RI and MA Lease Areas—Transiting

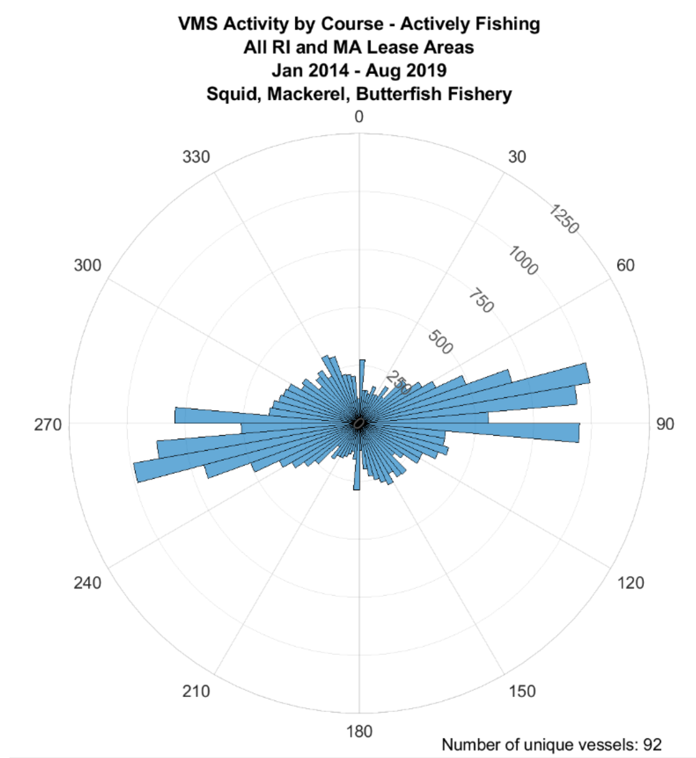

Figure 3.11-6: Squid, Mackerel, Butterfish Fishery in RI and MA Lease Areas—Fishing

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APPENDIX C

Analysis of Incomplete or Unavailable Information

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APPENDIX C. ANALYSIS OF INCOMPLETE OR UNAVAILABLE INFORMATION

In accordance with Section 1502.22 of the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA), when an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an Environmental Impact Statement (EIS) and when information is incomplete or unavailable, the agency shall always make clear that such information is lacking.

Given the substantial geographic and temporal scale of the cumulative impacts analysis, some information regarding ongoing activities is unavailable or only available in qualitative or summary form. For reasonably foreseeable offshore wind activities, project-specific information is available only from the seven Construction and Operations Plans (COPs) lessees have submitted for Bureau of Ocean Energy Management (BOEM) review. Considering that such information is lacking for other offshore wind activities considered reasonably foreseeable, and several of the COPs submitted are currently under review to determine whether they contain complete and sufficient information for environmental review, a series of assumptions were necessary in order to conduct the cumulative impacts analysis. These assumptions are listed in Appendix A, and additional information is provided in Chapter 1. Although these assumptions were necessary to allow the analysis to proceed with a reasonable degree of certainty, it is not known whether or to what degree future offshore wind activities will proceed according to these assumptions.

In addition to the uncertainty regarding future activities contemplated in the cumulative impacts analysis, information is also incomplete or unavailable regarding the likely consequences of various activities on the resources analyzed.[1] When incomplete or unavailable information was identified, BOEM considered whether the information was relevant to the assessment of impacts and essential to its analysis of alternatives based upon the resource analyzed. If essential to a reasoned choice among the alternatives, BOEM considered whether it was possible to obtain the information, if the cost of obtaining it was exorbitant, and if it could not be obtained, applied acceptable scientific methodologies to inform the analysis in light of this incomplete or unavailable information. For example, conclusive information on many impacts of the offshore wind industry may not be available for years, and certainly not within the contemplated timeframe of this NEPA process. In its place, subject-matter experts (SMEs) have used the scientifically credible information available and accepted scientific methodologies to evaluate impacts on the resources while this information is unavailable.

C.1. INCOMPLETE OR UNAVAILABLE INFORMATION ANALYSIS FOR RESOURCE AREAS

C.1.1. Air Quality

Although a quantitative emissions inventory analysis of the region over the next 30 years would more accurately assess the overall change in emissions from the proposed Project, any action alternative would lead to reduced emissions and can only lead to a net improvement in air quality. The differences among action alternatives with respect to direct emissions due to construction, operations and maintenance, and decommissioning of the proposed Project would likely be small. As such, the analysis provided in this Supplemental Environmental Impact Statement (SEIS) is sufficient to support sound scientific judgements and informed decision making related to the use of the offshore portions of the Project area. In summary, BOEM does not believe that there is incomplete or unavailable information on air quality that is essential to a reasoned choice among alternatives.

C.1.2. Water Quality

No incomplete or unavailable information related to the analysis of impacts on water quality was identified.

C.1.3. Terrestrial and Coastal Fauna

Although the preferred habitats of terrestrial and coastal fauna are generally known, exact abundances and distributions of various fauna are likely to remain unknown for the foreseeable future. However, the species inventories and other information from nearby areas provide an adequate basis for evaluating the fauna likely to inhabit the Project area. Additionally, the onshore activities proposed involve only common, industry standard activities for which impacts are generally understood. As such, the analysis provided in this SEIS is sufficient to make a reasoned choice among the alternatives and there is no incomplete or unavailable information needed to conduct the impact assessment.

C.1.4. Birds

There will always be some level of incomplete Information on the distribution and habitat use of marine birds in the offshore portions of the Project area, as habitat use and distribution varies between season, species, and years. However, the Vineyard Wind 1 Project area has been sampled approximately 49 times from 2007 to 2015, and the results were used to inform the predictive models and analyze the potential adverse impacts on bird resources in the Draft EIS and the SEIS. Additionally, there will always be some level of uncertainty regarding the potential for collision risk and avoidance behaviors for some of the bird species that may be present within the offshore portions of the Project area, as the Vineyard Wind 1 Project represents the first utility-scale offshore wind project in the United States. To put the potential for bird mortality associated with operating wind turbine generators (WTGs) on the Outer Continental Shelf (OCS) in context, this SEIS relies upon data

[1] The impacts of climate change would contribute to significant adverse impacts for all resource areas. However, the resource impacts from climate change would not differ among alternatives, and are not further identified here, since these impacts are not essential for a reasoned choice among alternatives.

collected at onshore wind facilities and makes assumptions regarding the applicability of these data to offshore environments. The estimated mortality provided in the SEIS could be larger than expected due to differences in species groups present, differences in the life history and behavior of those species, as well as differences in the offshore marine environment compared to onshore habitats. Similarly, the SEIS also provides an estimate of potential mortality using the Band (2012) collision risk model and Avian Stochastic collision risk model. Modeling is commonly used to predict the potential mortality rates for marine bird species in Europe and the United States (BOEM 2015, 2019a). Model inputs include monthly bird densities, flight behavior, avoidance behavior, and other factors to determine the estimated number of annual collisions with operating WTGs. Due to inherent data limitations, these models often represent only a subset of species potentially present. Collison risk models used to estimate the potential mortality associated with the proposed Project as well as other future offshore wind development include 12 common marine birds that may be present on the Atlantic OCS and, due to data limitations, does not fully account for all of the species that may encounter operating WTGs. However, the datasets used by both Vineyard Wind and BOEM to assess the potential for exposure of marine birds to the Wind Development Area represent the best available data and provide context at both local and regional scales. The regional scale assessment of potential exposure to the Wind Development Area include data that was collected on a large regional and temporal scale and includes aerial and boat survey data collected from 1978 to 2014 to develop long-term average annual and seasonal models. Further, sufficient information on collision risk and avoidance behaviors observed in related species at European offshore wind projects is available and was used to analyze and corroborate the potential for these impacts as a result of the proposed Project (e.g., Petersen et al. 2006; Skov et al. 2018). As such, the analysis provided in this SEIS is sufficient to support sound scientific judgements and informed decision making related distribution and use of the offshore portions of the Project area as well as to the potential for collision risk and avoidance behaviors in bird resources. In summary, BOEM does not believe that there is incomplete or unavailable information on avian resources that is essential to a reasoned choice among alternatives.

C.1.5. Bats

There will always be some level of incomplete Information on the distribution and habitat use of migratory tree bats in the offshore portions of the Project area, as habitat use and distribution varies between season and species. Additionally, there is some level of uncertainty regarding the potential collision risk to individual bats that may be present within the offshore portions of the Project area, as the Vineyard Wind 1 Project represents the first utility-scale offshore wind project in the U.S. However, sufficient information on collision risk to migratory tree bats observed at land-based U.S. wind projects exists and it was used to analyze and corroborate the potential for this impact as a result of the proposed Project. In addition, and as described in the Draft EIS Section 3.3.3 and the SEIS Appendix A Section A.8.4, the likelihood of an individual migratory tree bat encountering an operating WTG during migration is very low. As such, the analysis provided in this SEIS is sufficient to support sound scientific judgements and informed decision making related distribution and use of the offshore portions of the Project area as well as to the potential for collision risk of migratory tree bats. In summary, BOEM does not believe that there is incomplete or unavailable information on bat resources that is essential to a reasoned choice among alternatives.

C.1.6. Coastal Habitats

No incomplete or unavailable information related to the analysis of impacts on coastal habitats was identified.

C.1.7. Benthic Resources

Although there is uncertainty regarding the temporal distribution of benthic (animal) resources and periods during which they might be especially vulnerable to disturbance, Vineyard Wind's surveys of benthic resources in 2016, 2017, and 2018, and other broad-scale studies (Guida et al. 2017; The Nature Conservancy 2014) provided a suitable basis for generally predicting the species, abundances, and distributions of benthic resources in the cumulative analysis area. Uncertainty also exists regarding the impact of impact-producing factors (IPFs) on benthic resources. For example, specific stimulus-response information on acoustics and electromagnetic field (EMF) are not fully known for all benthic species, but there is information from benthic monitoring at European wind facilities and the Block Island Wind Farm in the United States. Similarly, specific secondary impacts such as changes in diets through the food chain resulting from habitat modification and synergistic behavioral impacts from multiple IPFs are not fully known. Again, results of benthic monitoring at European wind facilities and the Block Island Wind Farm in the United States provide for a broad understanding of the overall impacts of these IPFs combined, if not individually. This information is sufficient to support sound scientific judgements and informed decision making related to the cumulative impacts. In summary, BOEM does not believe that there is incomplete or unavailable information on benthic resources that is essential to a reasoned choice among alternatives.

C.1.8. Finfish, Invertebrates, and Essential Fish Habitat

There is uncertainty regarding the spatial and temporal occurrence of finfish, invertebrates, and essential fish habitat throughout the entire cumulative analysis area. However, broad-scale information is available from sources such as federal fisheries management plans, Guida et al. (2017), and surveys completed to support COP submission. There is also uncertainty regarding Behavioral impacts from each IPF individually and cumulatively. Again, BOEM is able to draw on years of fish monitoring results in Europe as well analogous activities in the United States (e.g., bridge construction, oil and gas platforms, etc.). Thus, BOEM extrapolated or drew assumptions from what is known about similar species and/or situations. Additional information, extrapolations, and assumptions are presented in SEIS Section 3.4 and references therein, in the Biological Assessment (BOEM 2019a), and in the Essential Fish Habitat Assessment (BOEM 2019b). Sufficient information on the likely effects of each impact-producing factor exists and was used to analyze the potential impacts that could result from the proposed Project and past, present, and reasonably foreseeable actions. In summary, BOEM does not believe that there is incomplete or unavailable information on finfish, invertebrates, and essential fish habitat that is essential to a reasoned choice among alternatives.

C.1.9. Marine Mammals

Information is incomplete regarding the interaction of marine mammals with submarine cables (e.g., EMF). These gaps remain partly owing to difficulties in evaluating impacts at population scale around these deployments (Taormina et al. 2018). Scientific studies examining effects of altered EMF on marine mammals have not been conducted. The large size of marine mammals and other logistical constraints make experimental studies infeasible. However, a summary of existing relevant evidence is provided in the BOEM-sponsored report by Normandeau et al. (2011) cited in SEIS Section 3.5. Using this information, BOEM's SMEs have estimated that marine mammals would likely have a low risk of impacts related to EMF from submarine cables, because the high mobility of marine mammals would tend to reduce exposure time.

There is uncertainty regarding the response of large whale species to new structures due to the novelty of this type of development on the Atlantic OCS. Although 2,066 new structures are anticipated under the cumulative impact scenario, spacing will be sufficient to allow unobstructed access within and between wind facilities. While avoidance of wind development areas (WDAs) due to new structures is possible, it is unlikely, due to the whales' size relative to turbine spacing. Additionally, there is some uncertainty around how the new structures would influence the development of the cold pool and the anticipated reef impact, both of which can result in potential impacts to marine mammal prey species. The potential consequences of these impacts on the Atlantic OCS are unknown. Monitoring studies would be able to determine more precisely any changes in whale behavior.

There is also uncertainty regarding the cumulative acoustic impacts associated with pile-driving activities. The available information relative to impacts on marine mammals from pile driving associated with offshore wind development is primarily limited to information on harbor porpoises and seals, as the vast majority of this research has occurred at European offshore wind projects where large whales are uncommon. At this time, it is unclear if marine mammals would cease feeding, and when individuals would resume normal feeding, migrating, breeding, etc. behaviors once daily pile-driving activities cease, or if secondary impacts would persist. Under the cumulative impact scenario, individual whales may be exposed to acoustic impacts from multiple projects in 1 day or to acoustic impacts from one or more projects over the course of multiple days. The consequences of these exposure scenarios have been analyzed with the best available information, but a lack of real world observations on species' responses to pile driving result in uncertainty. Additionally, it is currently unclear how sequential years of construction of multiple projects would impact marine mammals.

Finally, there are no data relative to the impacts of elevated turbidity on marine mammals, though it is assumed that normal movements may be altered. However, these movements would be expected to be too small to be meaningfully measured and no adverse impacts would be expected from marine mammals swimming through turbidity plumes to leave the turbid area (NOAA 2020).

BOEM believes that the overall costs of obtaining this information are exorbitant or the means to obtain it are not known. Although the above information is unavailable, BOEM extrapolated or drew assumptions from what is known about similar species and/or situations. Additional information, extrapolations, and assumptions are presented in Section 3.5 of this SEIS and references therein, and in the Biological Assessment submitted to NOAA (BOEM 2019a). In summary, BOEM used the best available information to predict potential impacts on marine mammals, and the analysis provided in this SEIS is sufficient to support sound scientific judgements and informed decision making related to the proposed uses of the offshore portions of the Project area.

C.1.10. Sea Turtles

The effects of EMF on sea turtles, both foraging and migrating, are not completely understood. However, the available relevant information is summarized in the BOEM-sponsored report by Normandeau et al. (2011) cited in Section 3.6 of the SEIS and utilized in the Biological Assessment for the proposed Project. Although the thresholds for EMF disturbing various sea turtle behaviors are not known, no adverse effects on sea turtles from the numerous submarine power cables around the world have been documented to occur. In addition, no nesting beaches, critical habitat, or other biologically important habitats were identified in the proposed Project area.

There is also uncertainty relative to sea turtle responses to construction activities on the Atlantic OCS. Some potential for displacement from construction areas exists. However, if this displacement occurs, it is unclear whether individuals would be displaced into lower quality habitat, or into areas with higher risk of fatal vessel interactions. Additionally it is currently unclear whether concurrent construction of multiple projects or construction completed over sequential years would be the most impactful to sea turtles. There is also uncertainty regarding the cumulative acoustic impacts associated with pile-driving activities. At this time it is unclear if sea turtles would cease feeding, and when individuals would resume normal feeding, migrating, breeding, etc. behaviors once daily pile-driving activities cease, or if secondary impacts would continue. Under the cumulative impact scenario, individual sea turtles may be exposed to acoustic impacts from multiple projects in 1 day or to acoustic impacts from one or more projects over the course of multiple days. The consequences of these exposure scenarios have been analyzed with the best available information, but a lack of real world observations on species responses to pile driving result in uncertainty.

Some uncertainty exists regarding the potential for sea turtle responses to Federal Aviation Administration (FAA) and navigation lighting associated with offshore wind development. Given the placement of the new structures far from nesting beaches, no impacts to nesting female or hatchling sea turtles would be expected. However, at this time, it is unclear as to whether the required lighting on WTGs and electrical service platforms would be visible under the water surface, and if so, how sea turtles would respond to such light. Although the potential impacts of offshore lighting on juvenile and adult sea turtles is uncertain, WTG lighting is not anticipated to have any detectable impacts (adverse or beneficial) on any age class of sea turtles in the offshore environment given the current lack of evidence that platform lighting leads to impacts on sea turtles as shown by decades of oil and gas platform operation in the Gulf of Mexico, which can have considerably more lighting than offshore WTGs (BOEM 2019a).

Finally, information regarding the impacts of elevated turbidity on juvenile and adult sea turtles was not identified, though it is assumed that normal movements may be altered. However, these movements would be expected to be too small to be meaningfully measured and no adverse impacts would be expected from sea turtles swimming through turbidity plumes to leave the turbid area (NOAA 2020).

BOEM believes that the overall costs of obtaining this information are exorbitant or the means to obtain it are not known. Although the above information is unavailable, BOEM extrapolated or drew assumptions from what is known about similar species and/or situations. Additional information, extrapolations, and assumptions are presented in SEIS Section 3.6 and references therein, and in the Biological Assessment submitted to NOAA (BOEM 2019a). As such, the analysis provided in this SEIS is sufficient to support sound scientific judgements and informed decision making related to the proposed uses of the offshore portions of the Project area. In summary, BOEM used the best available information to predict potential impacts on sea turtles, and the analysis provided in this SEIS is sufficient to support sound scientific judgements and informed decision making related to the proposed uses of the offshore portions of the Project.

C.1.11. Demographics, Employment, and Economics

Vineyard Wind's economic analysis estimated the employment and economic requirements and outputs for the Proposed Action, but BOEM's estimates for changes in jobs, expenditures, and economic outputs for demographic, employment, and economic impacts for Alternatives B through F were based on comparisons with Vineyard Wind's estimate. This provided sufficient information for the evaluation of demographics, employment, and economics to support a reasoned choice among alternatives. There is some inherent uncertainty in forecasting how economic variables in various areas will evolve over time. However, BOEM does not believe that there is specific incomplete or unavailable information on demographics, employment, and economics that is essential to a reasoned choice among alternatives.

C.1.12. Environmental Justice

Evaluations of impacts on environmental justice communities rely on assessment of impacts on other resources. As a result, while there is no incomplete or unavailable information related to the analysis of environmental justice impacts itself, incomplete or unavailable information related to other resources—including but not limited to the data discussed in Sections C.1.13, C.1.15, and C.1.17—also affect the analysis of impacts on environmental justice communities. As discussed in the sections previously referenced, the incomplete and unavailable information was either not relevant to a reasoned choice among alternatives or BOEM's SMEs used alternative methods to perform an analysis that would allow the decision maker to make a reasoned choice among the alternatives considered.

C.1.13. Cultural, Historical, and Archaeological Resources

Information pertaining to the identification of historic properties within certain portions of the marine archaeology area of potential effect will not be available until after the Record of Decision is issued and the COP is approved. BOEM will prepare a Memorandum of Agreement with the Section 106 Consulting Parties allowing for deferred identification and evaluation of historic properties within this portion of the area of potential effect in accordance with BOEM's existing Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585, ensuring that a good faith effort to identify historic properties and assess effects is completed prior to construction. BOEM does not believe that this incomplete or unavailable information on marine archaeological resources is essential to a reasoned choice among alternatives.

C.1.14. Recreation and Tourism

No incomplete or unavailable information related to the analysis of impacts on recreation and tourism was identified.

C.1.15. Commercial Fisheries and For Hire Recreational Fishing

Fisheries are managed in the context of an incomplete understanding of fish stock dynamics and effects of environmental factors on fish populations. Although the fisheries information used in this assessment has limitations (e.g., vessel trip report data is an imprecise measurement of where fishing occurred; available historical data lacks consistency, making comparisons challenging), it does represent the best available data and sufficient information exists to support the findings presented herein.

BOEM has concluded that the information provided by NOAA in SEIS Section 3.14.2.1 and Appendix A Table A-1 regarding scientific research and surveys are sufficient to support the impact findings presented in the SEIS. Therefore, BOEM does not believe that there is incomplete or unavailable information on scientific surveys that is essential to a reasoned choice among alternatives.

C.1.16. Land Use and Coastal Infrastructure

No incomplete or unavailable information related to the analysis of impacts on land use and coastal infrastructure was identified.

C.1.17. Navigation and Vessel Traffic

The navigation and vessel traffic impact analysis in the Draft EIS and this SEIS is based on Automatic Identification System (AIS) data from vessels required to carry AIS (i.e., those 65 feet [19.8 meters] or greater in length) since March 2015, as well as Vessel Monitoring System (VMS) data for individual vessel trips. AIS data prior to March 2015 is currently unavailable. VMS data for fishing vessels provided by the National Marine Fisheries Service (NMFS) were the basis for polar histograms and other analytical outputs used in evaluating commercial and for-hire recreational fishing trips (see SEIS Section 3.11). Vineyard Wind's Navigational Risk Assessment also includes observations about VMS data, based on maps of 2006 to 2016 VMS data provided by the NMFS and the Northeast Regional Ocean Council. These observations supplement the AIS data by identifying areas of fishing vessel concentration within the WDA and surrounding area. As shown in Table 3.4.7-1 in the Draft EIS, some smaller recreational and fishing vessels carry an AIS; however, the AIS analysis likely excludes most vessels less than 65 feet (19.8 meters) long that traverse the WDA. In addition, the VMS data provided by NMFS excluded some non-fishing commercial and recreational vessel trips through the WDA and across the OECC. Nonetheless, the combination of AIS and VMS data described above represent the best available vessel traffic data, and is sufficient to enable BOEM to make a reasoned choice among alternatives.

The U.S. Coast Guard's (USCG's) Draft Massachusetts and Rhode Island Port Access Route Study (MARIPARS), evaluating the need for establishing vessel routing measures, was published in the Fed. Reg. on January 29, 2020 (USCG 2020). The Draft MARIPARS report recommended an aligned, regular, and gridded layout throughout the Rhode Island and Massachusetts lease areas that provides adequate sea room to facilitate predictable safe navigation throughout the contiguous leases. The recommendation includes three "lines of orientation," or predictable headings that vessels can take at any location within the contiguous lease areas. The Draft MARIPARS report stated that 1-nautical-mile-wide east-to-west paths would facilitate traditional fishing methods in the area, and 1-nautical-mile-wide north-to-south paths would provide the USCG with adequate access for search and rescue access. Finally, 0.6- to 0.8-nautical-mile-wide northwest-to-southeast paths would allow commercial fishing vessels to continue their travel from port, through the lease areas, and to fishing grounds. The five Rhode Island and Massachusetts offshore wind leaseholders have proposed a collaborative regional layout for wind turbines (1 x 1 nautical mile apart in fixed east-to-west rows and north-to-south columns, with 0.7 nautical mile theoretical transit lanes oriented northwest-southeast) across their respective BOEM leases (Geijerstam et al. 2019), which meets the layout rules set forth in the Draft MARIPARS report recommendations. Though the USCG attached to the MARIPARS Federal Register Docket the RODA proposal (RODA 2020) recommending additional transit corridors through the lease areas, the Draft MARIPARS concluded that if the layout in the recommendations were implemented, the USCG would not pursue any additional routing measures. As a cooperating agency with BOEM, BOEM and USCG will continue to consult over the course of the NEPA process for the proposed Project as it relates to navigational safety and other aspects, including the impacts associated with alternatives assessed. The USCG will make a final recommendation on transit routes after the comments received during the Draft MARIPARS comment period are assessed.

Based on the foregoing, BOEM does not believe that there is incomplete or unavailable information on navigation and vessel traffic that is essential to a reasoned choice among alternatives.

C.1.18. Other Uses

As specified in the Draft EIS, this category includes other uses of the OCS not addressed in other resource sections. In the context of the NEPA analysis, this includes marine mineral resources, military and national security uses, aviation and air traffic, offshore energy uses (aside from the proposed Project), land-based radar systems, and scientific research surveys. There is no incomplete or unavailable information related to the analysis of marine mineral resources, military and national security uses, aviation and air traffic, offshore energy uses (aside from the aspects described in this appendix for the proposed Project, and the reasonably foreseeable offshore wind projects for which BOEM has not received COPs), and land-based radar systems.

As discussed in SEIS Section 3.14.2.1 for scientific research and surveys, preliminary analyses of the impacts on survey areal coverage show substantial impacts to NMFS' ability to continue using current methods to fulfill its mission of precisely and accurately assessing fish and shellfish stocks for the purpose of fisheries management and assessing protected species for the purpose of protected species management. Despite the foregoing, BOEM has concluded that the information provided by NOAA in SEIS Section 3.14.2.1 and Appendix A Table A-1 regarding scientific research and surveys are sufficient to support the impact findings presented in the SEIS. Therefore, BOEM does not believe that there is incomplete or unavailable information on scientific surveys that is essential to a reasoned choice among alternatives.

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APPENDIX D

Other Required Analyses and Consultation and Coordination

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APPENDIX D. OTHER REQUIRED ANALYSES AND CONSULTATION AND COORDINATION

To comply with the page limits in the Department of the Interior's Secretarial Order 3355 and focus on the impacts of most concern, the Bureau of Ocean Energy Management (BOEM) has included in this appendix the discussion on alternatives considered but not analyzed in detail and consultation and coordination. In addition, unavoidable adverse impacts associated with a proposed action, irreversible or irretrievable commitments of resources, and 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 are included, although these analyses are largely unchanged from the Draft Environmental Impact Statement (EIS). As was the case in the Draft EIS, these analyses focus on the potential impacts of the Proposed Action. The potential effects of the action alternatives are characterized in SEIS Chapter 3 and Appendix A.

D.1. ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

Several alternatives have been considered but eliminated from detailed study. These alternatives were identified through coordination with state and federal agencies and input from the public and potentially affected stakeholders through the Draft EIS scoping process (Draft EIS Section 4.3) and the Supplemental EIS (SEIS) development process. BOEM evaluated the alternatives described below, and excluded them from further consideration because they did not meet the purpose and need and/or did not meet the screening criteria. These alternatives are presented below with a brief discussion of the reasons for their elimination as prescribed in Council on Environmental Quality (CEQ) regulations at 40 Code of Federal Regulations (CFR) § 1502.14(a) and Department of the Interior regulations at 43 CFR § 46.420(b-c). The screening criteria used included:

- Consistency with law and regulations;
- Operational, technical, and economic feasibility;
- Environmental impact; and
- Geographical considerations.

Alternative Wind Turbine Foundation Types: BOEM received comments suggesting the use of suction bucket foundations, gravity-based foundations, mobile jack-up platforms, or floating wind turbine foundation types to reduce impacts on marine mammals, sea turtles, and fish from pile driving associated with monopile and jacket foundations. These foundation types are not feasible within the Vineyard Wind 1 Offshore Wind Energy Project (Project) area due to, among other things, the seafloor substrate and water depths.

- The dense soils beneath an upper loose surficial layer of sand may prevent the full penetration required for stability of suction bucket foundations.
- The loose upper layer of sandy sediment also presents a settlement risk for gravity-based foundations.
- The water depths are too shallow in portions of the Project area for floating foundations, which is a technology that is unproven for a project the size of what is proposed by Vineyard Wind.

While these foundation types would not require pile driving, the larger footprint of suction bucket and gravity-based foundations would increase seabed disturbance. Additionally, these foundation types would create less room for fishing activities between turbines when compared to monopile or jacket foundations. Moreover, site preparation and dredging activities for suction bucket and gravity-based foundations could increase potential environmental impacts when compared to monopile or jacket foundations. Overall, these alternative foundation types are not feasible in the Project area and may increase long-term environmental impacts over those from monopile or jacket foundations within the Project area.

Alternative Landfall Location: BOEM received comments suggesting a cable landfall at Brayton Point instead of New Hampshire Avenue or Covell's Beach. If a high-voltage direct current transmission line were used, installation of a midway converter station and associated equipment would be required; this, in turn, would increase the offshore footprint of the proposed Project and introduce additional technical risk. Even if a high-voltage alternating current transmission line were used and an additional converter station were not required, it would likely have greater net environmental impacts due to the longer length of the Offshore Export Cable Corridor (OECC). Additional length of cable required for the offshore export cables could also increase impacts on fishing activities due to greater risk of snags for fishing gear. The Brayton Point location is therefore less operationally feasible and increases environmental impacts offshore.

Offshore Regional Transmission Network: Several commenters suggested that BOEM mandate the use of an offshore regional transmission cable system for the proposed Project. This alternative is unfeasible primarily because such a system does not yet exist, and BOEM has issued no right-of-way (ROWs) for such a system. BOEM has received unsolicited proposals for the development of two open access offshore transmission systems from Anbaric Development Partners LLC. One is named the New York and New Jersey Ocean Grid and the other is named the Southern New England Ocean Grid. The New York/New Jersey proposal would not connect to the Wind Development Area (WDA) or Massachusetts, though the Southern New England proposal could. However, there is no proposed timeline for when this could occur. Furthermore, it is unclear who would pay for transmission capacity in excess of what would be required for the Proposed Action. The proposed Project timeline would be substantially delayed by the time needed to properly plan a regional transmission network that would not reduce system resiliency or pose capacity issues for onshore substations. In addition, mandating the use of an offshore regional transmission cable system would not alter the need for Vineyard Wind to construct and maintain an offshore export cable, whose impacts are considered in the applicable analyzed alternatives. At the present time, these factors outweigh any potential future decrease in cumulative seabed disturbance that may result from having multiple projects sharing one regional cable network.

Shared Cable Corridor: Some commenters suggested that BOEM mandate the use of a shared cable corridor as the OECC. BOEM considers this alternative is unnecessary at the present time because construction of a cable within the OECC would not foreclose the future installation of cables for other offshore wind facilities along the same route. BOEM can authorize multiple cable easements and ROWs in parallel and in relatively close proximity. For example, 30 CFR § 585.302(b) states that the rights granted under a ROW for a transmission cable would not prevent the granting of other rights by the United States, either before or after the granting of the ROW, provided a subsequent authorization would not unreasonably interfere with the activities or existing operations. Moreover, as discussed above, requiring the construction of cables that accommodate future offshore wind facilities as part of the proposed Project could create capacity issues for onshore substations, and is it is unclear who would pay for transmission capacity in excess of what would be required for the Proposed Action. At this time, these factors outweigh any potential future decrease in cumulative seabed disturbance that may result from having multiple projects sharing one cable corridor.

Alternative Location for the Wind Energy Facility Outside of Lease OCS-A 0501: Locating the wind energy facility outside of lease area OCS-A 0501 would constitute a new Proposed Action, and would not address BOEM's regulatory need to respond to Vineyard Wind's proposal to build a large-scale commercial wind energy facility within a defined geographic area on Lease OCS-A 0501. BOEM would consider proposals on other existing leases through a separate regulatory process. Other potential lease areas may be considered at a later date. This alternative would therefore not meet the purpose and need of the proposed Project, and would effectively be the same as selecting Alternative G (No Action).

Alternative Location for the Wind Energy Facility Further Offshore in Lease OCS-A 0501: Several commenters have suggested that BOEM consider a project that is on Lease OCS-A 0501 but moves the entire project further offshore or further southwest, or both, extending outside the WDA. This alternative would decrease the potential for viewshed conflicts as compared to Alternative A, the Proposed Action, but the benefits of this alternative to visual impacts would likely be outweighed by increased seabed disturbance from a longer export cable, including the potential addition of a converter station, and longer vessel trips to the Project area during construction and operations. The evidence also does not indicate that moving the entire proposed Project further offshore within the lease area would reduce impacts on biological resources or commercial fishing. Moving the proposed Project further offshore would also severely impact the proposed Project's feasibility for several reasons. Particularly, it would delay permitting and heighten Project risk because additional surveys would be needed for some or all of the Project area. That delay and risk would be inconsistent with the goals of Executive Order (EO) 13807, could impact the proposed Project's ability to meet the requirements of its power purchase agreements, and could potentially make the proposed Project economically infeasible. Depending on how much further out the proposed Project is moved, this alternative could essentially constitute a different proposal. This alternative would therefore not meet the purpose and need of the proposed Project, and would effectively be the same as selecting Alternative G (No Action).

Alternative Spacing between Wind Energy Turbines: Several commenters have suggested an alternate spacing of 1.5 to 2 nautical miles or greater between wind turbine generators (WTGs), which would result in turbines outside the lease area. While this alternative could reduce impact on fishing opportunities within the Project area, it would result in placing turbines outside the lease area (Draft EIS Figure 2.1-6; Alternative Location for the Wind Energy Facility Outside of Lease OCS-A 0501) and would essentially constitute a different proposal. In addition, increased environmental impacts could occur from longer cabling required. This alternative would not meet the purpose and need of the proposed Project, and would effectively be the same as selecting Alternative G (No Action).

84 Wind Energy Turbines with Alternative Spacing: Several commenters suggested that BOEM should analyze in detail an alternative that contemplates the use of 84 9.5-megawatt (MW) WTGs, spaced with 1.5 nautical miles between them. Analysis of Automatic Identification System data indicates that 1 nautical mile spacing between WTGs is sufficient for fishing vessels to turn and navigate within the proposed Project area (Epsilon 2019), and no other available information indicates that increased spacing between WTGs would enhance maneuverability of vessels fishing within the proposed Project area. In addition, the submitted Vineyard Wind Construction and Operations Plan (COP) assumes a range in WTG sizes, and BOEM does not see a need to require the use of a specific turbine size. This alternative was not analyzed in detail because of this information and because BOEM expects it to result in more expected impacts than other alternatives being fully analyzed due to the increased spacing between WTGs that would translate to increased cabling and longer vessel trips.

Phased Development and Monitoring: Several commenters recommended an alternative under which BOEM would require phased development of the proposed Project. Under this alternative, BOEM would allow initial construction of only a portion of the turbines, require the first phase to be studied for several years, and then only permit the remainder of the turbines to be constructed if deemed environmentally acceptable (or subject to additional terms and conditions) based on the results of those studies. While this alternative might have the eventual effect of reducing some environmental impacts, a phased approach could present permitting challenges. This alternative would also, by its nature, create permitting delays and project risk that could potentially foreclose its economic feasibility. This alternative would therefore effectively be the same as selecting Alternative G (No Action).

Project Configuration That Does Not Interfere With Existing Public Views: Several commenters recommended an alternative where the proposed Project could not be seen from the coast of Nantucket, or in views that are culturally significant to tribes. No other specifics for this alternative were provided; therefore, based on the description provided, this alternative would require the proposed Project be built at a distance of greater than 35 miles (56.3 kilometers) in order for it not to be viewed from the coast of Nantucket, based on the curvature of the earth. Thus, this alternative would require eliminating all 106 turbine placement locations proposed under Vineyard Wind's COP, would require a longer OECC, and would result in increased duration of vessel trips during construction and operations. Furthermore, this alternative would allow for less than 80 WTGs within the southern portion of lease area OCS-A 0501. These technical challenges would potentially foreclose the proposed Project's economic feasibility. Therefore, this alternative would effectively be the same as selecting Alternative G (No Action).

Locate Project Outside Known Habitat For Federal or State-Listed Species. The entirety of Vineyard Wind's lease as well as other Outer Continental Shelf (OCS) areas in the vicinity include habitat for species listed as endangered or threatened under federal or state laws as well as habitat for non-listed species. Development elsewhere on the OCS that does not contain habitat for listed species is likely not feasible, possibly not even identifiable, and would not meet the purpose and need of the proposed Project. This alternative would effectively be the same as selecting Alternative G (No Action).

Project limited to 50 WTGs: Limiting the proposed Project to 50 WTGs would only allow for a project of a maximum of 700 MW, assuming the use of the 14 MW WTGs. A 700 MW project would not meet the purpose and need of the proposed Project and would impact the proposed Project's ability to meet the requirements of its power purchase agreements, potentially threatening its economic feasibility. This alternative would effectively be the same as selecting Alternative G (No Action).

Transit lane alternative with widths other than 2 and 4 nautical miles: An analysis of a range of transit lanes between 2 and 4 nautical miles or greater than 4 nautical miles is not needed to address stakeholder concerns. The primary transit lane widths identified through stakeholder discussions were 2 and 4 nautical miles. In addition, BOEM's subject matter experts believe, based on information available to them at this time, that an analysis of additional transit lane widths other than those analyzed in the Draft EIS and this SEIS (0.7 to 1 nautical mile in Alternative A; 2 and 4 nautical mile in Alternative F) would not provide the Secretary of the Interior significantly different information regarding impacts on affected resources when compared to the information obtained by the transit lanes BOEM is analyzing in this SEIS. BOEM's subject matter experts believe that the widths selected for analysis provide a representative view of the impacts and benefits that could result from establishing transit lanes ranging from 0.7 to 4 nautical miles.

Although some interested parties have suggested vessel transit lanes in the combined Rhode Island and Massachusetts Lease Areas (RI and MA Lease Areas) with widths in excess of 4 nautical miles, BOEM is unaware of any studies justifying that width. The closest metric to that suggestion that BOEM has seen (from U.K. Maritime Guidance MGN 543) is that routes should be wide enough to allow for a 20-degree course variation in rough conditions. For the 15-nautical mile long diagonal through the RI and MA Lease Areas, this would be a lane of 5.5 nautical miles. However, the context of MGN 543 indicates that this metric is intended for larger commercial vessels with less responsive steering and that are more heavily impacted by wind, such as the vessels moving through New York Harbor that are in excess of 800 feet. The fishing vessels transiting the RI and MA Lease Areas are much smaller, with the largest licensed fishing vessel in the area being 138 feet (42.1 meters). Nearby lanes intended for deep draft traffic include the Traffic Separation Schemes for Narragansett Bay (11.5-nautical mile long and 4-nautical mile wide) and Boston (127.5-nautical mile long and 4-nautical mile wide). These Traffic Separation Schemes see both a larger traffic volume and larger individual vessel size than the entirety of the RI and MA Lease Areas, and include a separation zone of 1 to 2 nautical miles in the middle of the lane. Therefore, BOEM does not believe that an analysis of this alternative is necessary.

D.2. CONSULTATION AND COORDINATION

D.2.1. Introduction

This chapter discusses public and agency involvement leading up to the preparation and publication of this SEIS, including formal consultations, cooperating agency exchanges, the public scoping comment period and correspondence. Consultation, coordination, and correspondence throughout the development of this SEIS occurred primarily through in-person meetings and teleconferences. BOEM coordinated with numerous agencies throughout the development of this document, as listed in Section D.2.3.2.

D.2.2. Consultations

The following section provides a summary and status of each consultation (ongoing, complete, and the opinion or finding of each consultation). The Bureau of Environmental Safety and Enforcement, U.S. Army Corps of Engineers, and U.S. Environmental Protection Agency are co-action agencies for the Endangered Species Act (ESA), Magnuson-Stevens Fishery Conservation and Management Act (MSA), and National Historic Preservation Act (NHPA) consultations.

D.2.2.1. Coastal Zone Management Act

The Coastal Zone Management Act requires that federal actions within and outside the coastal zone that have reasonably foreseeable effects on any coastal use or natural resource of the coastal zone be consistent with the enforceable policies of a state's federally approved coastal management program. On April 6, 2018, Vineyard Wind voluntarily submitted a federal consistency certification with the Massachusetts Coastal Zone Management (CZM) and the Rhode Island Costal Resources Management Council per 15 CFR § 930.76 Subpart E. Vineyard Wind's COP (Epsilon 2018) provided the necessary data and information under 15 CFR § 930.58. The States' concurrence is required before BOEM may approve or approve with conditions the Vineyard Wind COP per 30 CFR § 585.628(f) and 15 CFR § 930.130(1).

On February 28, 2019, the Rhode Island Costal Resources Management Council concurred with the Coastal Zone Management Act consistency certification filed by Vineyard Wind on April 6, 2018.[1] After multiple discussions and negotiations, Vineyard Wind agreed to provide fisheries mitigations as required by Rhode Island enforceable policies 11.10.5(C), (G), and (H), which includes a $4.2 million fund for direct compensation to Rhode Island fishermen for loss of equipment or claims of direct impact. In addition, Vineyard Wind will provide Rhode Island with $12.5 million to establish the Rhode Island Fisheries Future Viability Trust administered by a non-profit entity independent of the State of Rhode Island and the Fishermen's Advisory Board. Finally, Vineyard Wind provided a commercial fisheries Biological Assessment (BA) monitoring plan summary as required by Rhode Island enforceable policies. On May 22, 2020, Massachusetts CZM concurred with the Coastal Zone Management Act consistency certification filed by Vineyard Wind on April 6, 2018 (Massachusetts CZM 2020). With oversight of Massachusetts CZM and input from key stakeholders, Vineyard Wind developed the Massachusetts Fisheries Compensatory Mitigation Plan and has entered into an agreement with the Massachusetts Executive Office of Energy and Environmental Affairs to establish two funds, the Compensatory Mitigation Fund ($19.2 million) and the Fisheries Innovation Fund ($1.75 million). The Compensatory Mitigation Fund will be used to compensate for any claims of direct, indirect, and cumulative economic impacts to Massachusetts vessels or fisheries interests and the Fisheries Innovation Fund will be used to support fisheries research and innovation. Additional details are provided in SEIS Section 3.11 and Table 3.11-5 in Appendix B.

D.2.2.2. Endangered Species Act

Section 7(a)(2) of the ESA of 1973, as amended (16 United States Code [USC] § 1531 et seq.), requires that each federal agency ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of those species. When the action of a federal agency may affect a protected species or its critical habitat, that agency is required to consult with either National Marine Fisheries Service (NMFS) or U.S. Fish and Wildlife Service (USFWS), depending upon the jurisdiction of the Services. Pursuant to 50 CFR § 402.07, BOEM has accepted designation as the lead federal agency for the purposes of fulfilling interagency consultation under Section 7 of the ESA for listed species under the jurisdiction of NMFS and USFWS. BOEM has initiated consultation on the proposed activities considered in this SEIS with both NMFS and USFWS for listed species under their respective jurisdictions. NMFS and USFWS have not designated any critical habitat in the WDA; thus, none will be affected. The sections below describe the status of consultations for each of the services.

National Marine Fisheries Service

On December 7, 2018, BOEM submitted a BA to NMFS and requested formal consultation under Section 7 of the ESA (BOEM 2018a). The Vineyard Wind BA assesses impacts from all aspects of the proposed Project, including construction, operation, maintenance, and decommissioning on marine ESA-listed species (non-marine species consultation is discussed below). BOEM transmitted a BA to NMFS and requested formal consultation under Section 7 of the ESA on December 7, 2018. BOEM subsequently transmitted additional information on the BA to NMFS on April 17, 2020, to account for modifications in the Vineyard Wind 1 Project Design Envelope. The scope of the BA covers the entirety of potential effects on ESA-listed species and designated critical habitat associated with the proposed Project. The analysis of effects and conclusions of the BA will be incorporated by reference and summarized into the Final EIS when published. BOEM has made the BA supplement materials available here: https://www.boem.gov/Vineyard-Wind/. NMFS initiated formal consultation on the Vineyard Wind 1 Project April 10, 2019. Formal consultation will be completed and a Biological Opinion issued by NMFS prior to the publication of the Record of Decision (ROD) issuance for the proposed Project.

U.S. Fish and Wildlife Service

On July 13, 2018, in preparation of the National Environmental Policy Act (NEPA) process and the BA for non-marine species such as birds and bats, BOEM used USFWS's Information for Planning and Consultation system[2] to determine if any ESA-listed, proposed, or candidate species may be present in the proposed Project area. The report identified five ESA-listed species with potential to occur in the proposed Project area: Northern long-eared bat (*Myotis septentrionalis*), Piping Plover (*Charadrius melodus*), Rufa Red Knot (*Calidris canutus rufa*), Roseate Tern (*Sterna dougallii dougallii*), and American chaffseed (*Schwalbea americana*) (USFWS 2018).

On December 7, 2018, BOEM submitted a BA to USFWS (BOEM 2018a); consultation with USFWS is ongoing and will be completed prior to issuance of the ROD. The Vineyard Wind BA assesses all aspects of the proposed Project, including construction, operation, maintenance, and decommissioning on USFWS listed species. The analysis of effects and conclusions of the BA will be incorporated by reference and summarized into the Final EIS when published. The BA is available here: https://www.boem.gov/Vineyard-Wind/. BOEM will update the BA to address updates to the Vineyard Wind 1 COP and submit to USFWS for their review and concurrence by July 2020. On May 24, 2019, BOEM utilized the Information for Planning and Consultation tool to determine what conservation measures, if any, would be required to minimize potential impacts on the Northern long-eared bat during tree-clearing activities for the onshore substation. BOEM will update the determination with new information from the Vineyard Wind 1 COP to clear an additional 0.2 acre (809 square meters) of forest. BOEM will need USFWS to confirm that the proposed tree-clearing activities would comply with the USFWS's January 5, 2016, Programmatic Biological Opinion, which satisfied USFWS responsibilities relative to the northern long-eared bat for

[1] More information regarding the consistency certification, including compensatory mitigation, is provided in SEIS Section 3.11 as well as at http://www.crmc.ri.gov/windenergy/vineyardwind.html.

[2] https://tinyurl.com/0501-ipac

this action under ESA Section 7(a)(2) (USFWS 2016; USFWS 2019). Consultation with USFWS will be completed prior to the publication of the ROD issuance for the proposed Project.

D.2.2.3. Government-to-Government Tribal Consultation

EO 13175 commits federal agencies to engage in government-to-government consultation with tribes when federal actions have tribal implications, and Secretarial Order No. 3317 requires U.S. Department of the Interior agencies to develop and participate in meaningful consultation with federally recognized tribes where a tribal implication may arise. A June 29, 2018, memorandum outlines BOEM's current tribal consultation policy. This memorandum states that "consultation is a deliberative process that aims to create effective collaboration and informed Federal decision-making" and is in keeping with the spirit and intent of the NHPA and NEPA, Executive and Secretarial Orders, and Department of the Interior Policy. BOEM implements tribal consultation policies through formal government-to-government consultation, informal dialogue, collaboration, and other engagement.

BOEM invited Tribal Historic Preservation Officers (THPOs) to the NEPA scoping meetings scheduled for April 16-20, 2018. On April 24, 2018, BOEM initiated formal consultations with six Tribes under the NHPA through individual letters mailed to THPOs and Tribal leaders with the Mashantucket (Western) Pequot Tribal Nation, the Mashpee Wampanoag Tribe of Massachusetts, the Mohegan Indian Tribe of Connecticut, the Narraganset Indian Tribe, the Shinnecock Indian Nation of New York, and the Wampanoag Tribe of Gay Head (Aquinnah). BOEM then sent individual invitations to THPOs and Deputy THPOs to participate in a June 26, 2018, webinar on the proposed Project.

On July 30, 2018, BOEM sent another set of emails to Tribal leaders and THPOs again requesting further government-to-government consultation as part of BOEM's ongoing effort to update the Tribes on developments in offshore wind. The Narragansett Indian Tribe, the Mohegan Indian Tribe, and the Mashantucket Pequot Tribe responded to this request. BOEM held government-to-government meetings with the Narragansett Indian Tribe at Tribal offices in Charlestown, Rhode Island, and jointly with the Mohegan Indian Tribe and the Mashantucket Pequot Tribe at Mashantucket, Connecticut, on August 21 and 22, 2018. All three tribes expressed interest in continuing consultation for offshore wind, and all emphasized the importance of early consultation in Project development. Between January 15 and 17, 2020, BOEM met again with the Mohegan Tribe of Connecticut, the Mashantucket Pequot Tribal Nation, and the Narragansett Indian Tribe to discuss multiple BOEM actions, including the Proposed Action. BOEM continues to consult with these and other Tribes on developments in offshore wind.

Tribal concerns include possible effects on marine mammals, other marine life, and the Nantucket Sound Traditional Cultural Property (TCP). A number of identified paleolandforms are likely contributing elements to the Nantucket Sound TCP due to their cultural significance to Native American tribes. One Tribe emphasized the importance of open sea views to the east during sunrise, as well as the night sky, while others emphasized their long historical association with the sea and islands off southern New England and the critical role of fishing and shellfish gathering. All of the Tribes emphasized the importance of understanding the interconnected nature of the human world, the sea, and the living things in both worlds.

D.2.2.4. National Historic Preservation Act

Section 106 of the NHPA (54 USC § 306108 et seq.) and its implementing regulations (36 CFR part 800) require federal agencies to consider the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation an opportunity to comment. BOEM has determined that the proposed Project is an undertaking subject to Section 106 review. The construction of WTGs, electrical service platforms, installation of electrical support cables, and development of staging areas are ground or seabed disturbing activities that may directly affect archaeological resources. The presence of WTGs may also introduce visual elements out of character with the historic setting of historic structures or landscapes; in cases where historic setting is a contributing element of historic properties' eligibility for the NRHP, the Project may adversely affect those historic properties.

BOEM fulfilled public involvement requirements for Section 106 of the NHPA through the NEPA public scoping and public meetings process, pursuant to 36 CFR § 800.2(d)(3). The Scoping Summary Report (BOEM 2018b), available on BOEM's project-specific website, summarizes comments on historic preservation issues.[3] On April 24, 2018, BOEM initiated consultation with six federally recognized tribes: the Mashantucket (Western) Pequot Tribal Nation, the Mashpee Wampanoag Tribe of Massachusetts, the Mohegan Indian Tribe of Connecticut, the Narraganset Indian Tribe, the Shinnecock Indian Nation of New York, and the Wampanoag Tribe of Gay Head (Aquinnah) (Section D.2.2.3). BOEM requested information on properties of historic/cultural significance that the proposed Project could affect, and offered BOEM's assistance in providing additional details and information on the proposed Project to the tribes.

On June 7, 2018, BOEM contacted representatives of local governments, state and local historical societies, economic development commissions, and other Federal agencies to solicit information on historic properties and determine their interest in participating as consulting parties. On June 26, 2018, BOEM conducted a webinar for consulting parties, with the goals of discussing the undertaking, defining the area of potential effect, and discussing BOEM's guidance for what constitutes a good faith effort to identify historic properties within the APE (BOEM 2017). On November 7, 2018, BOEM held a second Section 106 consultation meeting on the island of Nantucket, with the goal of discussing viewshed assessments, visual simulations, and assessing effects to historic properties.

[3] https://www.boem.gov/Vineyard-Wind/

On April 2, 2019, BOEM held a Section 106 consultation meeting in Hyannis, Massachusetts. The purpose of the meeting was to discuss mitigations for adverse effects to the Nantucket NHL and the Gay Head Light historic property; a framework Memorandum of Agreement (MOA) with treatment plans for resolving adverse effects to historic properties; and to present the results of the terrestrial and marine archaeological surveys conducted by Vineyard Wind to the consulting parties.

On April 10, 2019, BOEM notified the parties of its initial Finding of Adverse Effect for the Vineyard Wind 1 COP on the Gay Head Lighthouse and the Nantucket Island National Historic Landmark, pursuant to 36 CFR 800.5. Because the identification of historic properties was, at that time, ongoing for both marine and terrestrial archaeological resources portions of the APE, BOEM continued consultation with the parties.

In May and June 2019, the non-federally recognized Chappaquiddick Wampanoag Tribe notified BOEM of potential impacts from the Proposed Action to Chappaquiddick Island, which the Tribe considers a TCP. BOEM reviewed information provided by the Tribe and continued consultation under Section 106 of the NHPA. As a result of this and other comments, BOEM revised its Finding of Adverse Effect to incorporate additional identified historic properties that may be affected by the undertaking and to reflect comments received.

On June 26, 2019, BOEM held a meeting with representatives from the Mashpee Wampanoag, Wampanoag Tribe of Gay Head (Aquinnah, and the Mashantucket (Western) Pequot Tribal Nation in Hyannis, Massachusetts to discuss options to mitigate adverse effects to the paleolandforms. During this meeting, the representatives from BOEM and the Tribes discussed various options for mitigating adverse effects to paleolandforms that may be contributing elements to a Tribal TCP. This included a proposal by BOEM for a study designed to collect data from submerged paleolandscapes to develop a paleoenvironmental reconstruction of the subaerially exposed area when it was occupied Native American populations.

BOEM intends to continue consultations with the goal of developing an MOA to resolve adverse effects to the Nantucket NHL, Gay Head Light historic property, the Chappaquiddick Island TCP and submerged paleolandforms with the potential to contain pre-contact period sites. As previously discussed, BOEM must execute the MOA before issuance of the ROD.

D.2.2.5. Magnuson-Stevens Fishery Conservation and Management Act

Pursuant to Section 305(b) of the MSA, federal agencies are required to consult with NMFS on any action that may result in adverse effects on Essential Fish Habitat (EFH). NMFS regulations implementing the EFH provisions of the MSA can be found at 50 CFR § 600. As provided for in 50 CFR § 600.920(b), BOEM has accepted designation as the lead agency for the purposes of fulfilling EFH consultation obligations under Section 305(b) of the MSA. Certain OCS activities authorized by BOEM may result in adverse effects on EFH and, therefore, require consultation with NMFS. BOEM developed an EFH Assessment (BOEM 2019) concurrent with the Draft EIS, and transmitted the findings of that EFH Assessment to NMFS on December 7, 2018. BOEM's EFH Assessment determined that the proposed action would adversely affect quality and quantity of EFH for several species of managed fish. BOEM is working with NMFS on the proposed Project Design Envelope updates, changes to the EFH Assessment, and an updated response to the EFH Consultation Request.

D.2.2.6. Marine Mammal Protection Act

Section 101(a) of the Marine Mammal Protection Act (MMPA) (16 USC 1361) prohibits persons or vessels subject to the jurisdiction of the United States from taking any marine mammal in waters or on lands under the jurisdiction of the United States or on the high seas (16 USC 1372(a) (l), (a)(2)). Sections 101(a)(5)(A) and (D) of the MMPA provide exceptions to the prohibition on take, which give NMFS the authority to authorize the incidental but not intentional take[4] of small numbers of marine mammals, provided certain findings are made and statutory and regulatory procedures are met. ITAs may be issued as either (1) regulations and associated Letters of Authorization or (2) an Incidental Harassment Authorization (IHA).[5] Letters of Authorizations may be issued for up to a maximum period of 5 years, and IHAs may be issued for a maximum period of 1 year. NMFS has also promulgated regulations to implement the provisions of the MMPA governing the taking and importing of marine mammals (50 CFR 216) and has published application instructions that prescribe the procedures necessary to apply for an Incidental Take Authorization (ITA). U.S. citizens seeking to obtain authorization for the incidental take of marine mammals under NMFS's jurisdiction must comply with these regulations and application instructions in addition to the provisions of the MMPA.

Once NMFS determines an application is adequate and complete, NMFS has a corresponding duty to determine whether and how to authorize take of marine mammals incidental to the activities described in the application. To authorize the incidental take of marine mammals, NMFS evaluates the best available scientific information to determine whether the take would have a negligible impact on the affected marine mammal species or stocks and an immitigable impact on their availability for taking for subsistence uses. NMFS must also prescribe the "means of effecting the least practicable adverse impact" on the affected species or stocks and their habitat, and on the availability of those species or stocks for subsistence uses, as well as monitoring and reporting requirements.

[4] The term "take" means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (16 USC §1362(3)(13)). The incidental take of a marine mammal falls under three categories: mortality, serious injury, or harassment (i.e., injury and/or disruption of behavioral patterns). Harassment, as defined in the MMPA for non-military readiness activities (Section 3(8)(A)), is any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment) or any act of pursuit, torment, or annoyance that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns (Level B harassment). Disruption of behavioral patterns includes, but is not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.

[5] Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for taking for subsistence uses (where relevant).

On September 7, 2018, NMFS received a request from Vineyard Wind for an IHA pursuant to the MMPA for the take of marine mammals incidental to the proposed Project's construction. Based on the review of the initial application received, NMFS required and requested additional information from Vineyard Wind. Vineyard Wind complied with NMFS requests and submitted revised versions of the application on October 11, 2018, and January 28, 2019. NMFS deemed Vineyard Wind's final application adequate and complete on February 15, 2019. Because serious injury or mortality to marine mammals is not expected to result from Vineyard Wind's construction activities for the proposed Project, NMFS determined an IHA is appropriate and published a proposed IHA in the *Federal Register* (84 Fed. Reg. 18346) on April 30, 2019 for public review. In accordance with the One Federal Decision policy established by EO 13807, NMFS expects to issue a final ITA within 90 days of the ROD (expected in December 2020).

D.2.3. Development of the Supplemental Environmental Impact Statement

This section provides an overview of the development of this SEIS, including public scoping for the NEPA process, cooperating agency involvement, distribution of the Draft EIS for public review and comment, and distribution of this SEIS.

D.2.3.1. Scoping

On March 30, 2018, BOEM issued a Notice of Intent (NOI) to prepare an EIS consistent with the regulations implementing NEPA (42 USC § 4321 et seq.) to assess the potential impacts of the Proposed Action and Alternatives (Notice of Intent to Prepare an Environmental Impact Statement for Vineyard Wind's Proposed Wind Energy Facility, 83 Fed. Reg. 13777 [March 30, 2018]). The NOI commenced the public scoping process for identifying issues and potential alternatives for consideration in the EIS. BOEM held five public scoping meetings in the vicinity of the proposed Project area to solicit feedback and identify issues and potential alternatives for consideration in the EIS. Throughout the scoping process, federal agencies, state, local, and tribal governments, and the general public had the opportunity to help BOEM identify potential significant resources and issues, impact-producing factors, reasonable alternatives (e.g., size, geographic, seasonal, or other restrictions on construction and siting of facilities and activities), and potential mitigation measures to be analyzed in the EIS, as well as provide additional information. BOEM used the NEPA scoping process to initiate the Section 106 consultation process under the NHPA (54 USC § 300101 et seq.), as permitted by 36 CFR § 800.2(d)(3), and sought public input through the NOI regarding historic properties and potential effects to historic properties from activities associated with the Vineyard Wind COP (Epsilon 2018). BOEM also used this scoping process to begin informal ESA consultation. The formal scoping period lasted from March 30 through April 30, 2018.

BOEM accepted comment submissions on the NOI via the following mechanisms:

- Electronic submissions received via www.Regulations.gov on docket number BOEM-2018-0015;
- Electronic submissions received via email to a BOEM representative;
- Hard-copy comment letters submitted to BOEM via traditional mail;
- Hard-copy comment cards and/or letters received during each of the public scoping meetings; and
- Comments submitted verbally at each of the public scoping meetings.

BOEM held five public scoping meetings at the following locations and dates:

- April 16, 2018—Fairfield Inn and Suites, Waypoint Event Center, New Bedford, Massachusetts
- April 17, 2018—Martha's Vineyard Hebrew Center, Vineyard Haven, Massachusetts
- April 18, 2018 (a.m.)—Nantucket Middle School, Nantucket, Massachusetts
- April 18, 2018 (p.m.)—Double Tree Hotel, Hyannis, Massachusetts
- April 19, 2018—University of Rhode Island Ryan Center, Kingston, Rhode Island

BOEM reviewed and addressed, as appropriate, all scoping comments in the development of the Draft EIS, and used the comments to identify alternatives for analysis. A Scoping Summary Report (BOEM 2018b) summarizing the submissions received and the methods for analyzing them is available on BOEM's website at https://www.boem.gov/Vineyard-Wind/. In addition, all public scoping submissions received can be viewed online at http://www.regulations.gov by typing "BOEM-2018-0015" in the search field. As detailed in the Scoping Summary Report, the resource areas or NEPA topics most referenced in the scoping comments include commercial fisheries and for-hire recreation fishing, Lewis Bay, the Project description, socioeconomics, alternatives, and others.

D.2.3.2. Cooperating Agencies

BOEM also used the NEPA scoping process to invite other federal agencies and state, tribal, and local governments to consider becoming cooperating agencies in the preparation of the Draft EIS. According to CEQ guidelines, qualified agencies and governments are those with "jurisdiction by law or special expertise" (CEQ 1981). BOEM asked potential cooperating agencies to consider their authority and capacity to assume the responsibilities of a cooperating agency, and to be aware that an agency's role in the environmental analysis neither enlarges nor diminishes the final decision-making authority of any other agency involved in the NEPA process. BOEM offered to provide potential cooperating agencies with a written summary of expectations for cooperating agencies, including time schedules and critical action dates, milestones, responsibilities, scope, and detail of cooperating agencies' contributions, and availability of pre-decisional information. BOEM also asked agencies to consider the "Factors for Determining Cooperating Agency Status" in Attachment 1 to CEQ's January 30, 2002, Memorandum for the Heads of Federal Agencies (CEQ 2002). BOEM held interagency meetings in 2018 on March 20, June 20, August 2, and October 15 to discuss the environmental review process, schedule, responsibilities, and consultation. Draft EIS Section 1.3 discusses the One Federal Decision process.

The following have supported preparation of the Draft and this SEIS as cooperating agencies:

- Bureau of Safety and Environmental Enforcement
- U.S. Environmental Protection Agency
- NMFS
- U.S. Army Corps of Engineers
- U.S. Coast Guard
- Massachusetts CZM
- Narragansett Indian Tribe
- Rhode Island Coastal Resource Management Council
- Rhode Island Department of Environmental Management

NMFS is serving as a cooperating agency pursuant to 40 CFR § 1501.6 because the scope of the Proposed Action and alternatives involve activities that have the potential to affect marine resources under its jurisdiction by law and special expertise. As applicable, permits and authorizations are issued pursuant to the MMPA, as amended (MMPA; 16 USC 1361 et seq.); the regulations governing the taking and importing of marine mammals (50 CFR § 216); the ESA (16 USC 1531 et seq.); and the regulations governing the taking, importing, and exporting of threatened and endangered species (50 CFR §§ 222-226). In accordance with 50 CFR Part 402, NMFS also serves as the Consulting Agency under Section 7 of the ESA for federal agencies proposing action that may affect marine resources listed as threatened or endangered. NMFS has additional responsibilities to conserve and manage fishery resources of the United States, which includes the authority to engage in consultations with other federal agencies pursuant to the MSA and 50 CFR Part 600 when proposed actions may adversely affect EFH.

D.2.3.3. Distribution of the Draft Environmental Impact Statement for Review and Comment

On December 7, 2018, BOEM published a Notice of Availability for the Draft EIS consistent with the regulations implementing NEPA (42 USC § 4321 et seq.) to assess the potential impacts of the Proposed Action and alternatives (Notice of Availability of a Draft Environmental Impact Statement for the Vineyard Wind LLC's Proposed Wind Energy Facility, 83 Fed. Reg. 63184 [December 8, 2018]). The Draft EIS was made available in electronic form for public viewing at https://www.boem.gov/Vineyard-Wind, and hard copies and/or CDs were delivered to libraries and other entities as specified in the Draft EIS Appendix E. The Notice of Availability commenced the public review and comment period of the Draft EIS. As described below, BOEM held five public hearings in the vicinity of the proposed Project area to solicit feedback and identify issues for consideration in the Final EIS preparation. Throughout the public review and comment period, federal agencies; state, local, and tribal governments, and the general public had the opportunity to provide comments on the Draft EIS in various ways including the following:

- Electronic submissions via www.Regulations.gov on docket number BOEM-2018-0069;
- Electronic submissions via email to a BOEM representative;
- Hard-copy comment letters submitted to BOEM via traditional mail;
- Hard-copy comment cards and/or letters received during each of the public hearings; and
- Comments submitted verbally at each of the public hearing meetings.

Initially, BOEM's 45-day public comment period was scheduled to close on January 22, 2019; however, due to the government shutdown, BOEM extended the comment period until February 22, 2019, and the public hearings were rescheduled as follows:

- February 11, 2019—Nantucket Atheneum, Nantucket, Massachusetts
- February 12, 2019—Martha's Vineyard Hebrew Center, Vineyard Haven, Massachusetts
- February 13, 2019—Double Tree Hotel, Hyannis, Massachusetts
- February 14, 2019—Fairfield Inn and Suites, Waypoint Event Center, New Bedford, Massachusetts
- February 15, 2019—Narragansett Community Center, Narragansett, Rhode Island

The topics most referenced during the Draft EIS comment period included commercial fisheries and for-hire recreational fishing, cumulative impacts, mitigation, finfish, invertebrates, and essential fish habitat, and purpose and need. BOEM reviewed and will consider all public submissions in the Final EIS development. All public comment submissions received on the Draft EIS can be viewed online at http://www.regulations.gov by typing "BOEM-2018-0069" in the search field.

D.2.3.4. Distribution of the Supplemental Environmental Impact Statement for Review and Comment

As mentioned above, comments received from stakeholders and cooperating agencies on the Draft EIS requested BOEM to expand the cumulative impact analysis for the proposed Project. Considering such comments, and taking into account recent state offshore wind procurement announcements since Draft EIS publication, BOEM has expanded its cumulative analysis based on the determination that a greater build out of offshore wind capacity is reasonably foreseeable than was analyzed in the initial Draft EIS. BOEM therefore decided to supplement the Draft EIS and solicit comments on the cumulative impacts analysis.

This SEIS is available in electronic form for public viewing at https://www.boem.gov/Vineyard-Wind/. BOEM has delivered hard copies and/or CDs of this SEIS to the entities listed in Appendix F. Publication of this SEIS initiates a 45-day comment period where government agencies, members of the public, and interested stakeholders can provide comments and input. BOEM will accept comments in any of the following ways:

- Hard-copy form, delivered by hand or by mail, enclosed in an envelope labeled "Vineyard Wind 1 COP EIS" and addressed to Program Manager, Office of Renewable Energy, Bureau of Ocean Energy Management, 45600 Woodland Road, Sterling, Virginia 20166. Comments must be received or postmarked no later than July 27, 2020.
- The regulations.gov web portal. Navigate to http://www.regulations.gov and searching for docket number "BOEM-2020-0005." Click the "Comment Now!" button to the right of the document link. Enter your information and comment, then click "Submit."
- Public meetings. Participate in an SEIS public meeting per the information listed in the Notice of Availability and provide written or verbal comments.

BOEM will assess and consider all comments received from the Draft EIS public comment period as well as during the SEIS public comment period in the Final EIS. This is to be consistent with 40 CFR 1503.4 Response to Comments. Comments on an EIS are different than scoping comments, which are considered at the agency's discretion.

D.3. Unavoidable Adverse Impacts of the Proposed Action

The CEQ's 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. Table D.3-1 provides a listing of such impacts. Most potential unavoidable adverse impacts associated with the Proposed Action would occur during the construction phase and would be temporary. SEIS Chapter 3 and Appendix A provides additional information on the potential impacts listed below.

All impacts from past, present, and reasonably foreseeable future activities are still expected to occur as described in the No Action Alternative analysis in this SEIS and the Draft EIS, regardless of whether or not the Proposed Action is approved.

Table D.3-1: Potential Unavoidable Adverse Impacts of the Proposed Action

Resource Area	Potential Unavoidable Adverse Impact of the Proposed Action
Air Quality	• Air quality impacts from emissions from engines associated with vessel traffic, construction activities, and equipment operation
Water Quality	• Increase in suspended sediments due to seafloor disturbance during construction, maintenance, and decommissioning activities
Terrestrial and Coastal Fauna	• Habitat-alteration-induced impacts, avoidance behavior, and individual mortality due to clearing and grading activities
Birds and Bats	• Displacement and avoidance behavior due to habitat loss/alteration, equipment noise, and vessel traffic • Individual mortality due to collisions with operating WTGs
Coastal Habitats	• Increase in suspended sediments and habitat-quality effects due to seafloor disturbance
Benthic Resources	• Increase in suspended sediments and resulting effects due to seafloor disturbance • Habitat quality impacts including reduction in habitat as a result of seafloor surface alternations • Disturbance, displacement, and avoidance behavior due to habitat loss/alteration, equipment noise, and vessel traffic • Individual mortality due to construction activities • Conversion of soft-bottom habitat to new hard-bottom habitat
Finfish, Invertebrates, and Essential Fish Habitat	• Increase in suspended sediments and resulting effects due to seafloor disturbance • Habitat quality alterations or loss of habitat • Displacement, disturbance, and avoidance behavior due to habitat loss/alteration, equipment noise, vessel traffic, increased turbidity, sediment deposition, and electromagnetic fields • Individual mortality due to construction and dredging activities
Marine Mammals	• Displacement, disturbance, and avoidance behavior due to habitat loss/alteration, equipment noise, vessel traffic, increased turbidity, and sediment deposition during construction and operations • Temporary loss of acoustic habitat and increased potential for vessel strikes
Sea Turtles	• Disturbance, displacement, and avoidance behavior due to habitat loss/alteration, equipment noise, vessel traffic, increased turbidity, sediment deposition, and electromagnetic fields
Demographics, Employment, and Economics	• Disruption of marine activities and resulting economic effects in the Lewis Bay area if the New Hampshire Avenue landfall location is selected as part of the Proposed Action
Environmental Justice	• Disruption of marine activities and resulting economic effects in the Lewis Bay area if the New Hampshire Avenue landfall location is selected as part of the Proposed Action
Cultural, Historical, and Archaeological Resources	• Impacts on viewsheds of and to historic properties
Recreation and Tourism	• Disruption of coastal recreation activities during onshore construction, such as beach access • Viewshed effects from the WTGs altering enjoyment of marine and coastal recreation and tourism activities • Disruption to access or temporary restriction of in-water recreational activities from construction of offshore project elements • Hindrances to some types of recreational fishing from the WTGs during operation
Commercial Fisheries and For-Hire Recreational Fishing	• Disruption to access or temporary restriction in 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

Resource Area	Potential Unavoidable Adverse Impact of the Proposed Action
Land Use and Coastal Infrastructure	• Land use disturbance due to construction as well as effects due to noise, vibration, and travel delays
Navigation and Vessel Traffic	• Changes in vessel transit patterns
Other Uses	• Disruption to offshore scientific research and surveys

WTG = wind turbine generator

D.4. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

CEQ's NEPA-implementing regulations (40 CFR § 1502.16) require that an EIS review the potential impacts on irreversible or irretrievable commitments of resources resulting from implementation of a proposed action. CEQ considers a commitment of a resource irreversible when the primary or secondary impacts from its use limit the future options for its use. Irreversible commitment of resources typically applies to impacts of nonrenewable resources such as marine minerals or cultural resources. The irreversible commitment of resources occurs due to the use or destruction of a specific resource. An irretrievable commitment refers to the use, loss, or consumption of a resource, particularly a renewable resource, for a period of time.

Table D.4-1 provides a listing of potential irreversible and irretrievable impacts by resource area. SEIS Chapter 3 and Appendix A provides additional information on the impacts summarized below.

Table D.4-1: Irreversible and Irretrievable Commitment of Resources by Resource Area

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Air Quality	No	No	BOEM expects air emissions to be in compliance with permits regulating air quality standards, and emissions would be temporary 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 or major impacts on existing inland waterbodies or wetlands. Turbidity impacts in the marine and coastal environment would be short-term.
Terrestrial and Coastal Fauna	Yes	Yes	Removal or disturbance of habitat associated with clearing and grading activities, as well as construction of the substation, could potentially create minor irreversible and irretrievable impacts.
Birds and Bats	No	No	Based on the healthy populations of bird species more susceptible to collision with operating WTGs, displacement, avoidance behavior, and individual mortality due to collisions with operating WTGs are not expected to be irreversible or irretrievable. Assuming implementation of time-of-year restrictions for tree clearing, the same would be true for bats. Irreversible and irretrievable impacts on bird species could occur if one or more individuals of species listed under ESA were injured or killed. However, on-going consultation with the USFWS would identify mitigation measures that would reduce or eliminate the potential for such impacts on listed species.
Coastal Habitats	No	No	Vineyard Wind would restore the onshore landfall site selected to original conditions, and turbidity impacts would be short-term and not lead to irreversible or irretrievable impacts. Changes in seabed composition/habitat as a result of cable protection could result in negligible to minor beneficial impacts.
Benthic Resources	No	No	Although local mortality could occur, BOEM does not anticipate population-level impacts on benthic organisms; habitat could recover after decommissioning activities.
Finfish, Invertebrates, and Essential Fish Habitat	No	No	Although local mortality could occur, BOEM does not anticipate population-level impacts. The Vineyard Wind 1 Project could alter habitat during construction and operations but could restore the habitat after decommissioning.
Marine Mammals	No	Yes	Irreversible impacts on marine mammals could occur if one or more individuals of species listed under ESA were injured or killed; however, mitigation measures would reduce or eliminate the potential for such impacts on listed species. Irretrievable impacts could occur if individuals or populations grow more slowly as a result of displacement from the Project area.
Sea Turtles	No	Yes	Irreversible impacts on sea turtles could occur if one or more individuals of species listed under ESA were injured or killed; however, mitigation measures would reduce or eliminate the potential for impacts on listed species. Irretrievable impacts could occur if individuals or populations grow more slowly as a result of displacement from the Project area.
Demographics, Employment, and Economics	No	Yes	A temporary increase of contractor needs, housing needs, and supply requirements could occur during construction activities. This could lead to an irretrievable loss of workers for other projects, and increased housing and supply costs.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Environmental Justice	No	Yes	Potential environmental justice impacts, if any, would be short-term and localized, unless the New Hampshire Avenue landfall site were used, in which case there would be irretrievable impacts on environmental justice communities and marine businesses dependent on Lewis Bay.
Cultural, Historical, and Archeological Resources	Yes	Yes	Although unlikely, unanticipated removal or disturbance of previously unidentified cultural resources onshore and offshore could result in irreversible and irretrievable impacts.
Recreation and Tourism	No	No	Construction activities near the shore could result in a minor, temporary loss of use of the land for recreation and tourism purposes.
Commercial Fisheries and For-Hire Recreational Fishing	No	Yes	Based on the anticipated duration of construction and operations, BOEM does not anticipate impacts on commercial fisheries to result in irreversible impacts. The Vineyard Wind 1 Project could alter habitat during construction and operations, limit access to fishing areas during construction, or reduce vessel maneuverability during operations. However, the decommissioning of the Project would reverse those impacts. Irretrievable impacts could occur due to the loss of use of fishing areas at an individual permit level.
Land Use and Coastal Infrastructure	Yes	Yes	Land use required for construction and operation activities, such as the land proposed for the substation, could result in a minor irreversible impact. Construction activities could result in a minor irretrievable impact due to the temporary loss of use of the land for otherwise typical activities. Onshore facilities may or may not be decommissioned.
Navigation and Vessel Traffic	No	Yes	Based on the anticipated duration of construction and operations, BOEM does not anticipate impacts on vessel traffic to result in irreversible impacts. Irretrievable impacts could occur due to changes in transit routes, which could be less efficient during the life of the Project.
Other Uses	No	Yes	Disruption of offshore scientific research and surveys would occur during proposed Project construction, operations, and decommissioning activities but they could resume after the Project is decommissioned.

BOEM = Bureau of Ocean Energy Management; ESA = Endangered Species Act; USFWS = U.S. Fish and Wildlife Service;
WTG = wind turbine generator

D.5. 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) require that an EIS address the relationship between short-term use of the environment and the potential impacts of such use on the maintenance and enhancement of long-term productivity. Such impacts could occur as a result of a reduction in the flexibility to pursue other options in the future, or assignment of a specific area (land or marine) or resource to a certain use that would not allow other uses, particularly beneficial uses, to occur at a later date. An important consideration when analyzing such effects is whether the short-term environmental effects of the action will result in detrimental effects to long-term productivity of the affected areas or resources.

As assessed in SEIS Chapter 3 and Appendix A, BOEM anticipates that the majority of the potential adverse effects associated with the Proposed Action would occur during construction activities, and would be short-term in nature and minor or moderate. These effects would cease after decommissioning activities. In assessing the relationships between short-term use of the environment and the maintenance and enhancement of long-term productivity, it is important to consider the long-term benefits of the Proposed Action, which include:

- Promotion of clean and safe development of domestic energy sources and clean energy job creation;
- Promotion of renewable energy to help ensure geopolitical security, combat climate change, and provide electricity that is affordable, reliable, safe, secure, and clean;
- Delivery of power to the New England energy grid to contribute to Massachusetts's renewable energy requirements, particularly, the Commonwealth's mandate that distribution companies jointly and competitively solicit proposals for offshore wind energy generation; and
- Increased habitat for certain fish species.

Based on the anticipated potential impacts evaluated in this document and the Draft EIS that could occur during Proposed Action construction, operations, maintenance, and decommissioning, and with the exception of some potential impacts associated with onshore components, BOEM anticipates that the Proposed Action would not result in impacts that would significantly narrow the range of future uses of the environment. Removal or disturbance of habitat associated with onshore activities (e.g., construction of the proposed substation) could create long-term irreversible impacts. For purposes of this analysis, BOEM assumes that the irreversible impacts presented in D.4, Irreversible and Irretrievable Commitment of Resources would be long-term. After completion of the Proposed Action's operations and decommissioning phases, however, BOEM expects the majority of marine and onshore environments to return to normal long-term productivity levels.

D.6. References

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APPENDIX E

Project Design Envelope and Maximum-Case Scenario

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APPENDIX E. PROJECT DESIGN ENVELOPE AND MAXIMUM-CASE SCENARIO

As characterized in the Draft Environmental Impact Statement (Draft EIS), Vineyard Wind LLC (Vineyard Wind) would implement a Project Design Envelope (PDE) concept. This concept allows Vineyard Wind to define and bracket proposed Project characteristics for environmental review and permitting while maintaining a reasonable degree of flexibility for selection and purchase of Project components such as wind turbine generators (WTGs), foundations, submarine cables, and offshore substations.[1]

The Bureau of Ocean Energy Management's (BOEM) invited Vineyard Wind and other lessees to submit Construction and Operation Plans (COPs) using the PDE concept–providing sufficiently detailed information within a reasonable range of parameters to analyze a "maximum-case scenario" within those parameters for each affected environmental resource. BOEM identified and verified that the maximum-case scenario based on the PDE provided by Vineyard Wind, and analyzed in the Draft EIS and this Supplement to the Draft EIS (SEIS), could reasonably occur if approved. This approach is intended to provide flexibility for lessees and allow BOEM to analyze environmental impacts in a manner that minimizes the need for subsequent environmental and technical reviews.

This SEIS assesses the impacts of the reasonable range of Project designs that are described in the Vineyard Wind COP by using the "maximum-case scenario" process. The maximum-case scenario analyzes the aspects of each design parameter that would result in the greatest impact for each physical, biological, and socioeconomic resource. As described in Chapter 2, this SEIS evaluates the relevant updates of the Vineyard Wind COP that have been made since the Draft EIS was published, namely the potential use of larger, up 14-megawatt (MW) WTGs instead of up to 10-MW WTGs. In doing so, potential impacts of the Proposed Action and each action alternative are evaluated using the maximum-case scenario.

Certain resources evaluated in this SEIS may have multiple maximum-case scenarios, and the most impactful design parameters may not be the same for all resources. For example, larger WTGs could be more impactful for aviation (because they are taller), whereas smaller WTGs could be more impactful to birds, and bats (because there would be a greater number). This appendix provides an update to Appendix G of the Draft EIS and presents detailed tables outlining the most impacting design parameter by resource area.

[1] Additional information and guidance related to the PDE concept can be found here: https://www.boem.gov/Draft-Design-Envelope-Guidance/.

Table E-1: Proposed Action Design Envelope Parameters

Capacity and Arrangement		
Wind Facility Capacity	Approximately 800 MW [a]	
Wind Turbine Generator Foundation Arrangement Envelope	Up to 100 monopiles	Up to 10 may be jacket foundations
Wind Turbine Generators	**Minimum**	**Maximum**
Turbine Generation Capacity	8 MW	14 MW
Number of Turbine Positions [b]	57	106
Number of Turbines Installed	57	Up to 100
Total Tip Height	627 ft (191 m) MLLW [c]	837 ft (255 m) MLLW [c]
Hub Height	358 ft (109 m) MLLW [c]	473 ft (144 m) MLLW [c]
Rotor Diameter	538 ft (164 m) MLLW	729 ft (222 m) MLLW
Tip Clearance	89 ft (27 m) MLLW [c]	105 ft (32 m) MLLW [c]
Platform Level/Interface Level Height for Monopile	62 ft (19 m) MLLW [c]	75 ft (23 m) MLLW [c]
Tower Diameter for WTG	20 ft (6 m)	28 ft (8.5 m)
Monopile Foundations	**Minimum**	**Maximum**
Diameter	25 ft (7.5 m)	34 ft (10.3 m)
Pile footprint	490 ft^2 (45.5 m^2)	908 ft^2 (84.3 m^2)
Height between Seabed and MLLW (water depth)	121 ft (37 m)	162 ft (49.5 m)
Penetration	66 ft (20 m)	148 ft (45 m)
Transition Piece Tower Diameter	20 ft (6 m)	28 ft (8.5 m)
Transition Piece Length	59 ft (18 m)	98 ft (30 m)
Platform Level/Interface Level Height	64 ft (19.5 m)	74 ft (22.5 m)
Number of Piles/Foundation	1	1
Number of Piles Driven/Day within 24 hours [d]	1	2
Typical Foundation Time to Pile Drive [e]	approximately 3 hours	approximately 3 hours
Hammer size	Up to 4,000 kJ	Up to 4,000 kJ
Jacket (Pin Piles) Foundation	**Minimum**	**Maximum**
Diameter for WTG and ESP	5 ft (1.5 m)	10 ft (3 m)
Jacket Structure Height for WTG	180 ft (55 m)	262 ft (80 m)
Jacket Structure Height for ESP	180 ft (55 m)	213 ft (65 m)
Platform Level/Interface Level Height for WTG and ESP	74 ft (22.5 m) MLLW	94 ft (28.5 m) MLLW
Pile Penetration for WTG	98 ft (30 m)	197 ft (60 m)
Pile Penetration for ESP	98 ft (30 m)	246 ft (75 m)
Pile Footprint for WTG	59 ft (18 m)	115 ft (35 m)
Pile Footprint for ESP	59 ft (18 m)	248 ft (45 m)
Number of Piles/Foundation	3 to 4	3 to 4
Number of Piles Driven/Day within 24 Hours [d]	1 (up to 4 pin piles)	
Typical Foundation Time to Pile Drive [e]	approximately 3 hours	
Hammer Size	Up to 3,000 kJ	
Scour Protection for Foundations	**Minimum**	**Maximum**
Scour Protection Area at Each Monopile WTG and ESP	up to 16,146 ft^2 (1,500 m^2)	up to 22,600 ft^2 (2,100 m^2)
Scour Protection Volume at Each Monopile WTG and ESP	up to 52,972 ft^3 (1,500 m^3)	up to 127,133 ft^3 (3,600 m^3)
Scour Protection Area at Each Jacket WTG	up to 13,993 ft^2 (1,300 m^2)	up to 19,375 ft^2 (1,800 m^2)
Scour Protection Volume at Each Jacket WTG	up to 45,909 ft^3 (1,300 m^3)	up to 91,818 ft^3 (2,600 m^3)
Scour Protection Area at Each Jacket ESP	up to 13,993 ft^2 (1,300 m^2)	up to 26,900 ft^2 (2,500 m^2)
Scour Protection Volume at Each Jacket ESP	up to 45,909 ft^3 (1,300 m^3)	up to 134,196 ft^3 (3,800 m^3)

Electrical Service Platform (ESP)		
Maximum Dimensions	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	
Number of Conventional ESPs	1 (800 MW)	2 (400 MW each)
Number of Transformers per ESP	1	2
Foundation Type	Monopile	Jacket
Number of Piles/Foundation	1	3 to 4
Maximum Height	215 ft (65.5 m) MLLW	218 ft (66.5 m) MLLW
Inter-Array Cable (66 kV)	Minimum	Maximum
Number of Foundations per Inter-Array Cable	6	10
Inter-Array Cable Length		171 mi (275 km)
Protection Method (rock placement, concrete mattresses, half-shell)		Up to 10% of route
Target Burial Depth	5 ft (1.5 m)	8 ft (2.5 m)
Export and Inter-Link Cable (220 kV)	Minimum	Maximum
Number of Export Cables within Corridor		2
Target Burial Depth	5 ft (1.5 m)	8 ft (2.5 m)
Maximum Length of Export Cable (assuming two cables)		98 mi (158 km)
Typical separation distance of Export Cable (assuming two cables)		328 ft (100 m)
Total Corridor Width for Export Cable (two cables) [f]	2,657 ft (810 m)	3,280 ft (1,000 m)
Protection Method (rock placement, concrete mattresses, half-shell)		Up to 10% of route
Maximum Length of Inter-Link Cable		6.2 mi (10 km)
Export Cables Dredging (width corridor per cable)		65.6 ft (20 m)
Export Cables Total Dredging Area		up to 69 acres (0.28 km^2)
Export Cables Total Dredging Volume		up to 214,500 cy (164,000 m^3)
Landfall and Onshore Components	Option 1, Western Route	Option 2, Eastern Route
Landfall Sites	Covell's Beach (Barnstable)	New Hampshire Avenue (Yarmouth)
Landfall Transition Method	HDD	HDD, Direct Bury via Open Cut
Length of Onshore Cable	5.3 to 5.4 mi (8.7 to 8.9 km)	5.1 to 6.1 mi (8.2 to 9.8 km)

cy = cubic yards; ESP = electrical service platform; ft = foot; ft^2 = square feet; ft^3 = cubic feet; HDD = horizontal directional drilling; kJ = kilojoule; km = kilometer; km2 = square kilometers; kV = kilovolt; m = meter; m^2 = square meters; m^3 = cubic meters; mi = mile; MLLW = mean lower low water; MW = megawatt; WTG = wind turbine generator

[a] Vineyard Wind's Proposed Action is for an approximately 800-MW offshore wind energy project. This SEIS evaluates the potential impacts of a facility up to 800 MW to ensure that it covers projects constructed with a smaller capacity.

[b] Additional WTG positions allow for spare turbine locations or additional capacity to account for environmental or engineering challenges.

[c] Elevations relative to mean higher high water are approximately 3 feet (1 meter) lower than those relative to MLLW.

[d] Work would not be performed concurrently. No drilling is anticipated; however, it may be required if a large boulder or refusal is met. If drilling is required, a rotary drilling unit would be mobilized. Similarly, vibratory hammering could be used if deemed appropriate by the installation contractor.

[e] Vineyard Wind has estimated that typical pile driving for a monopile is expected to take less than approximately 3 hours to achieve the target penetration depth, and that pile driving for the jacket foundation would take approximately 3 hours to achieve the target penetration depth. Different hammer sizes are used for installation of the monopile and jacket foundations.

[f] Corridor width for siting purposes; each trench would be approximately 3.2 feet (1 meter) wide and there would be an up to 3.3-6.6 feet (1-2 meter) wide temporary disturbance zone from the tracks or skids of the cable installation.

Table E-2: Design Parameters Consistent for All Scenarios

Project Element	Description
Foundation Construction Method	Pile driving
Foundation and Wind Turbine Generator (WTG) Installation Vessel Type	Jack-up vessel, vessel on dynamic positioning, feeder barges/vessels
Electrical Service Platform Installation Vessel Type	Jack-up vessel, vessel on dynamic positioning, feeder barges/vessels, specialized crane vessel
Inter-array Cable Installation Method (includes a pre-lay grapnel run)	Jetting or jet plow but could use mechanical plow, mechanical trenching
Inter-array Cable Installation Vessel Type	Jack-up vessel, vessel on dynamic positioning, feeder barges/vessels
Export Cable Installation Method (includes a pre-lay grapnel run)	Jet plow, mechanical plow, mechanical trenching, dredging in some locations to achieve burial depth
Export Cable Installation Vessel Type	Anchored vessel, vessel on dynamic positioning with feeder barges
WTG Coloring	RAL 9010 Pure White or RAL 7035 Light Grey
Federal Aviation Administration (FAA) Obstruction Lighting	Two synchronized L-864 aviation red flashing obstruction lights—WTG nacelle; 30 flashes per minute will be used for air navigation lighting (note that if the WTG's total tip height is 699 feet or greater, there would be at least three additional low-intensity L-810 flashing red lights at a point approximately midway between the top of the nacelle and sea level)
FAA Obstruction Lighting Method	Aircraft Detection Lighting System that would automatically activate all FAA lights (see row above) when aircraft approach; alternatively, the proposed Project may use a system that automatically adjusts lighting intensity to in response to visibility conditions
United States Coast Guard (USCG) Lighting	Two yellow flashing lights, each turbine approximately 20– 23 meters above mean lower low water; will be visible at 2 and/or 5 nautical miles
Navigational Boating Warning Tools	Sound signals and automatic identification system transponders
Landfall Transition	Underground concrete transition vaults
Onshore Cable Construction Protection	Underground duct banks of polyvinyl chloride pipes encased in concrete

Table E-3: Project Design Envelope Maximum-Case Scenario per Resource

Design Parameter	Air Quality	Water Quality	Terrestrial and Coastal Fauna	Birds	Bats	Coastal Habitat	Benthic Resources	Finfish, Invertebrates, and Essential Fish Habitat	Marine Mammals and Sea Turtles	Economics and Environmental Justice	Cultural, Historical, and Archaeological Resources	Recreation and Tourism	Commercial Fisheries and For-Hire Commercial Fishing	Land Use and Coastal Infrastructure	Navigation and Vessel Traffic	Other Uses
Wind Facility Capacity [a]	800 MW	800 MW	NA	800 MW	800 MW	NA	800 MW	800 MW	800 MW	800 MW	800 MW	800 MW	800 MW	NA	800 MW	800 MW
WTG Foundation Arrangement Envelope	NA	NA	NA	Evaluate both scenarios	Evaluate both scenarios	NA	Evaluate both scenarios	Evaluate both scenarios	Evaluate both scenarios	NA	Evaluate both scenarios	NA	Evaluate both scenarios	NA	Evaluate both scenarios	NA
WTGs and Foundation																
Turbine Size	8 MW due to more turbine construction	8 MW due to more turbines	NA	8 MW due to more turbines	8 MW due to more turbines	NA	8 MW due to more seafloor disturbance	NA	8 MW due to more surface occupancy	14 MW for economics; 10 MW for environmental justice	Range of 8 MW to 14 MW due to amount of disturbance (smaller) and visual effects (larger)	Range of 8 MW to 14 MW due to amount of disturbance (lower) and visual effects (greater)	8 MW due to more surface occupancy	NA	8 MW due to more potential for collision	14 MW due to total height
Number of Turbine Positions [b]	106 due to total number of trips required for construction	106 due to the total potential sediment disturbance, spills	NA	106 due to more potential for collision and more air space being occupied	106 due to more potential for collision and more air space being occupied	NA	106 due to the total potential surface disturbance	106 due to more potential for loss of area and change of habitat	106 due to more potential for noise and loss of area	106 due to more potential for noise and loss of area	106 due to more potential effects on resources due to disturbance	106 due to more potential for loss of area and change of habitat	106 due to more potential for collision and loss of area	NA	106 due to more potential for collision/ allisions	106 due to total number potential hazards
Number of Turbines Installed	100	100	NA	100	100	NA	100	100	100	57 for economics; 100 for environmental justice	100 due to amount of disturbance; 57 for visual effects	100	100	NA	100	100
Tip Height [c]	NA	NA	NA	627 ft (191 m) MLLW	837 ft (255 m) MLLW	NA	NA	NA	NA	837 ft (255 m) MLLW	627 ft (191 m) MLLW	837 ft (255 m) MLLW	627 ft (191 m) MLLW	NA	627 ft (191 m) MLLW	837 ft (255 m) MLLW
Hub Height [c]	NA	NA	NA	358 ft (109 m) MLLW	473 ft (144 m) MLLW	NA	NA	NA	NA	473 ft (144 m) MLLW	358 ft (109 m) MLLW	473 ft (144 m) MLLW	358 ft (109 m) MLLW	NA	358 ft (109 m) MLLW	473 ft (144 m) MLLW
Rotor Diameter [c]	NA	NA	NA	538 ft (164 m)	729 ft (222 m) MLLW	NA	NA	NA	NA	729 ft (222 m) MLLW	538 ft (164 m)	729 ft (222 m) MLLW	538 ft (164 m)	NA	538 ft (164 m)	729 ft (222 m) MLLW
Tip Clearance [c]	NA	NA	NA	89 ft (27 m) MLLW	105 ft (32 m) MLLW	NA	NA	NA	NA	105 ft (32 m) MLLW	105 ft (32 m) MLLW	105 ft (32 m) MLLW	89 ft (27 m) MLLW	NA	89 ft (27 m) MLLW	105 ft (32 m) MLLW
Platform Level/ Interface Level Height for Monopile [c]	NA	NA	NA	62 ft (19 m) MLLW	75 ft (23 m) MLLW	NA	NA	NA	NA	75 ft (23 m) MLLW	62 ft (19 m) MLLW	75 ft (23 m) MLLW	62 ft (19 m) MLLW	NA	62 ft (19 m) MLLW	75 ft (23 m) MLLW
Tower Diameter for WTG	NA	28 ft (8.5 m)	NA	NA	NA	NA	NA	NA	NA	NA	28 ft (8.5 m)	28 ft (8.5 m)	28 ft (8.5 m)	NA	28 ft (8.5 m)	28 ft (8.5 m)
Monopile Foundation																
Diameter	NA	34 ft (10.3 m)	NA	34 ft (10.3 m)	34 ft (10.3 m)	NA	34 ft (10.3 m)	34 ft (10.3 m)	34 ft (10.3 m)	NA	34 ft (10.3 m)	34 ft (10.3 m)	34 ft (10.3 m)	NA	34 ft (10.3 m)	NA
Pile Footprint	NA	908 ft^2 (84.3 m^2)	NA	908 ft^2 (84.3 m^2)	908 ft^2 (84.3 m^2)	NA	908 ft^2 (84.3 m^2)	908 ft^2 (84.3 m^2)	908 ft^2 (84.3 m^2)	NA	908 ft^2 (84.3 m^2)	908 ft^2 (84.3 m^2)	908 ft^2 (84.3 m^2)	NA	908 ft^2 (84.3 m^2)	NA
Height between Seabed and MLLW (water depth)	NA	162 ft (49.5 m)	NA	162 ft (49.5 m)	NA	NA	NA	NA	NA	NA	162 ft (49.5 m)	121 ft (37 m)	121 ft (37 m)	NA	121 ft (37 m)	162 ft (49.5 m)
Penetration	NA	148 ft (45 m)	NA	NA	NA	NA	148 ft (45 m)	148 ft (45 m)	148 ft (45 m)	NA	148 ft (45 m)	NA	148 ft (45 m)	NA	148 ft (45 m)	NA
Transition Piece Tower Diameter	NA	28 ft (8.5 m)	NA	NA	NA	NA	28 ft (8.5 m)	NA	NA	NA	28 ft (8.5 m)	28 ft (8.5 m)	28 ft (8.5 m)	NA	28 ft (8.5 m)	28 ft (8.5 m)
Transition Piece Length	NA	98 ft (30 m)	NA	98 ft (30 m)	NA	NA	NA	NA	NA	NA	98 ft (30 m)	98 ft (30 m)	59 ft (18 m)	NA	59 ft (18 m)	98 ft (30 m)
Platform Level/Interface Level Height	NA	74 ft (22.5 m)	NA	74 ft (22.5 m)	74 ft (22.5 m)	NA	NA	NA	NA	NA	74 ft (22.5 m)	64 ft (19.5 m)	64 ft (19.5 m)	NA	64 ft (19.5 m)	74 ft (22.5 m)
Number of Piles/Foundation	NA	1	NA	NA	NA	NA	1	1	1	NA	1	1	1	NA	1	NA
Number of Piles Driven/Day within 24 hours [d]	NA	2	NA	NA	NA	NA	2	2	2	NA	2	2	2	NA	2	NA

Design Parameter	Air Quality	Water Quality	Terrestrial and Coastal Fauna	Birds	Bats	Coastal Habitat	Benthic Resources	Finfish, Invertebrates, and Essential Fish Habitat	Marine Mammals and Sea Turtles	Economics and Environmental Justice	Cultural, Historical, and Archaeological Resources	Recreation and Tourism	Commercial Fisheries and For-Hire Commercial Fishing	Land Use and Coastal Infrastructure	Navigation and Vessel Traffic	Other Uses
Hammer size for Monopile Foundation	NA	NA	NA	4,000 kJ	NA	NA	4,000 kJ	4,000 kJ	4,000 kJ	NA	NA	4,000 kJ	4,000 kJ	NA	4,000 kJ	NA
Typical Foundation Time to Pile Drive [e]	NA	approximately 3 hours	NA	approximately 3 hours	NA	NA	approximately 3 hours	approximately 3 hours	approximately 3 hours	NA	approximately 3 hours	approximately 3 hours	approximately 3 hours	NA	approximately 3 hours	NA
Scour Protection Area at Each Monopile WTG and ESP	NA	up to 22,600 ft^2 (2,100 m^2)	NA	up to 22,600 ft^2 (2,100 m^2)	NA	NA	up to 22,600 ft^2 (2,100 m^2)	up to 22,600 ft^2 (2,100 m^2)	up to 22,600 ft^2 (2,100 m^2)	NA	up to 22,600 ft^2 (2,100 m^2)	up to 22,600 ft^2 (2,100 m^2)	up to 22,600 ft^2 (2,100 m^2)	NA	up to 22,600 ft^2 (2,100 m^2)	NA
Scour Protection Volume at Each Monopile WTG and ESP	NA	up to 127,133 ft^3 (3,600 m^3)	NA	up to 127,133 ft^3 (3,600 m^3)	NA	NA	up to 127,133 ft^3 (3,600 m^3)	up to 127,133 ft^3 (3,600 m^3)	up to 127,133 ft^3 (3,600 m^3)	NA	up to 127,133 ft^3 (3,600 m^3)	up to 127,133 ft^3 (3,600 m^3)	up to 127,133 ft^3 (3,600 m^3)	NA	up to 127,133 ft^3 (3,600 m^3)	NA
Jacket (Pin Piles) Foundation																
Diameter for WTG and ESP	NA	10 ft (3 m)	NA	10 ft (3 m)	10 ft (3 m)	NA	10 ft (3 m)	10 ft (3 m)	10 ft (3 m)	NA	10 ft (3 m)	10 ft (3 m)	10 ft (3 m)	NA	10 ft (3 m)	NA
Jacket Structure Height for WTG	NA	262 ft (80 m)	NA	262 ft (80 m)	262 ft (80 m)	NA	NA	NA	NA	NA	262 ft (80 m)	180 ft (55 m)	180 ft (55 m)	NA	262 ft (80 m)	262 ft (80 m)
Jacket Structure Height for ESP	NA	NA	NA	213 ft (65 m)	213 ft (65 m)	NA	NA	NA	NA	NA	213 ft (65 m)	180 ft (55 m)	180 ft (55 m)	NA	213 ft (65 m)	213 ft (65 m)
Platform Level/Interface Level Height for WTG and ESP	NA	94 ft (28.5 m) MLLW	NA	94 ft (28.5 m) MLLW	94 ft (28.5 m) MLLW	NA	NA	NA	NA	NA	94 ft (28.5 m) MLLW	74 ft (22.5 m) MLLW	74 ft (22.5 m) MLLW	NA	94 ft (28.5 m) MLLW	94 ft (28.5 m) MLLW
Pile Penetration for WTG	NA	197 ft (60 m)	NA	197 ft (60 m)	NA	NA	197 ft (60 m)	197 ft (60 m)	197 ft (60 m)	NA	197 ft (60 m)	NA	197 ft (60 m)	NA	197 ft (60 m)	NA
Pile Penetration for ESP	NA	246 ft (75 m)	NA	246 ft (75 m)	NA	NA	246 ft (75 m)	246 ft (75 m)	246 ft (75 m)	NA	246 ft (75 m)	NA	246 ft (75 m)	NA	246 ft (75 m)	NA
Pile Footprint for WTG	NA	NA	NA	115 ft (35 m)	NA	NA	115 ft (35 m)	115 ft (35 m)	115 ft (35 m)	NA	115 ft (35 m)	NA	115 ft (35 m)	NA	115 ft (35 m)	NA
Pile Footprint for ESP	NA	NA	NA	248 ft (45 m)	NA	NA	248 ft (45 m)	248 ft (45 m)	248 ft (45 m)	NA	248 ft (45 m)	NA	248 ft (45 m)	NA	248 ft (45 m)	NA
Number of Piles/ Foundation	NA	3 to 4	NA	3 to 4	NA	NA	3 to 4	3 to 4	3 to 4	NA	3 to 4	3 to 4	3 to 4	NA	3 to 4	NA
Number of Piles Driven/Day within 24 hours [d]	NA	2 monopiles (up to 4 pin piles)	NA	2 monopiles (up to 4 pin piles)	NA	NA	2 monopiles (up to 4 pin piles)	2 monopiles (up to 4 pin piles)	2 monopiles (up to 4 pin piles)	NA	2 monopiles (up to 4 pin piles)	2 monopiles (up to 4 pin piles)	2 monopiles (up to 4 pin piles)	NA	2 monopiles (up to 4 pin piles)	NA
Hammer size for Jacket Foundation	NA	NA	NA	3,000 kJ	NA	NA	3,000 kJ	3,000 kJ	3,000 kJ	NA	NA	3,000 kJ	3,000 kJ	NA	3,000 kJ	NA
Typical Jacket Time to Pile Drive	NA	less than approximately 3 hours	NA	less than approximately 3 hours	NA	NA	less than approximately 3 hours	less than approximately 3 hours	less than approximately 3 hours	NA	less than approximately 3 hours	less than approximately 3 hours	less than approximately 3 hours	NA	less than approximately 3 hours	NA
Scour Protection Area at Each Jacket WTG	NA	up to 19,375 ft^2 (1,800 m^2)	NA	up to 19,375 ft^2 (1,800 m^2)	NA	NA	up to 19,375 ft^2 (1,800 m^2)	up to 19,375 ft^2 (1,800 m^2)	up to 19,375 ft^2 (1,800 m^2)	NA	up to 19,375 ft^2 (1,800 m^2)	up to 19,375 ft^2 (1,800 m^2)	up to 19,375 ft^2 (1,800 m^2)	NA	up to 19,375 ft^2 (1,800 m^2)	NA
Scour Protection Volume at Each Jacket WTG	NA	up to 91,818 ft^3 (2,600 m^3)	NA	up to 91,818 ft^3 (2,600 m^3)	NA	NA	up to 91,818 ft^3 (2,600 m^3)	up to 91,818 ft^3 (2,600 m^3)	up to 91,818 ft^3 (2,600 m^3)	NA	up to 91,818 ft^3 (2,600 m^3)	up to 91,818 ft^3 (2,600 m^3)	up to 91,818 ft^3 (2,600 m^3)	NA	up to 91,818 ft^3 (2,600 m^3)	NA
Scour Protection Area at Each Jacket ESP	NA	up to 26,900 ft^2 (2,500 m^2)	NA	up to 26,900 ft^2 (2,500 m^2)	NA	NA	up to 26,900 ft^2 (2,500 m^2)	up to 26,900 ft^2 (2,500 m^2)	up to 26,900 ft^2 (2,500 m^2)	NA	up to 26,900 ft^2 (2,500 m^2)	up to 26,900 ft^2 (2,500 m^2)	up to 26,900 ft^2 (2,500 m^2)	NA	up to 26,900 ft^2 (2,500 m^2)	NA
Scour Protection Volume at Each Jacket ESP	NA	up to 134,196 ft^3 (3,800 m^3)	NA	up to 134,196 ft^3 (3,800 m^3)	NA	NA	up to 134,196 ft^3 (3,800 m^3)	up to 134,196 ft^3 (3,800 m^3)	up to 134,196 ft^3 (3,800 m^3)	NA	up to 134,196 ft^3 (3,800 m^3)	up to 134,196 ft^3 (3,800 m^3)	up to 134,196 ft^3 (3,800 m^3)	NA	up to 134,196 ft^3 (3,800 m^3)	NA
Electrical Service Platforms																
ESP Dimensions	NA	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	NA	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	NA	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	NA	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)	148 ft x 230 ft x 125 ft (45 m x 70 m x 38 m)

Design Parameter	Air Quality	Water Quality	Terrestrial and Coastal Fauna	Birds	Bats	Coastal Habitat	Benthic Resources	Finfish, Invertebrates, and Essential Fish Habitat	Marine Mammals and Sea Turtles	Economics and Environmental Justice	Cultural, Historical, and Archaeological Resources	Recreation and Tourism	Commercial Fisheries and For-Hire Commercial Fishing	Land Use and Coastal Infrastructure	Navigation and Vessel Traffic	Other Uses
Number of ESPs	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area	NA	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area	NA	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area	NA	Two ESPs due to more facilities occupying air and surface area	Two ESPs due to more facilities occupying air and surface area
Number of Transformers per ESP	NA	2	NA	2	2	NA	2	2	2	2	2	2	2	NA	2	2
ESP Foundation Type	NA	Jacket	NA	Jacket	Jacket	NA	Jacket	Jacket	Jacket	Jacket	Jacket	Jacket	Jacket	NA	Jacket	Jacket
ESP Number of Piles/Foundation	NA	3 to 4	NA	3 to 4	3 to 4	NA	3 to 4	3 to 4	3 to 4	3 to 4	3 to 4	3 to 4	3 to 4	NA	3 to 4	3 to 4
ESP Maximum Height	NA	NA	NA	218 ft (66.5 m) MLLW	218 ft (66.5 m) MLLW	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	218 ft (66.5 m) MLLW
Inter-array Cable (66 kV)																
Number of Foundations per Inter-Array	NA	6 to 10	NA	6 to 10	NA	6 to 10	6 to 10	6 to 10	6 to 10	6 to 10	6 to 10	6 to 10	6 to 10	NA	6 to 10	NA
Inter-Array Cable Length	NA	171 mi (275 km)	NA	171 mi (275 km)	NA	171 mi (275 km)	171 mi (275 km)	171 mi (275 km)	171 mi (275 km)	171 mi (275 km)	171 mi (275 km)	171 mi (275 km)	171 mi (275 km)	NA	171 mi (275 km)	NA
Target Burial Depth	NA	5 ft (1.5 m)	NA	NA	NA	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	NA
Inter-array Cable Installation Method (includes a pre-lay grapnel run)	Evaluate all traffic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Protection Method (rock placement, concrete mattresses, half-shell)	NA	up to 10% of inter-array route	NA	up to 10% of inter-array route	NA	up to 10% of inter-array route	up to 10% of inter-array route	up to 10% of inter-array route	up to 10% of inter-array route	up to 10% of inter-array route	up to 10% of inter-array route	up to 10% of inter-array route	up to 10% of inter-array route	NA	up to 10% of inter-array route	NA
Export and Inter-link Cable (220 kV)																
Number of Export Cables	NA	2	NA	NA	NA	2	2	2	2	2	2	2	2	2	2	NA
Burial Depth	NA	5 ft (1.5 m)	NA	NA	NA	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	5 ft (1.5 m)	NA
Maximum Length of Export Cable (assuming Two cables)	NA	98 mi (158 km)	NA	NA	NA	98 mi (158 km)	98 mi (158 km)	98 mi (158 km)	98 mi (158 km)	98 mi (158 km)	98 mi (158 km)	98 mi (158 km)	98 mi (158 km)	98 mi (158 km)	98 mi (158 km)	NA
Typical separation distance of Export Cable (assuming two cables)	NA	492 ft (100 m)	NA	492 ft (100 m)	NA	492 ft (100 m)	492 ft (100 m)	492 ft (100 m)	492 ft (100 m)	492 ft (100 m)	492 ft (100 m)	492 ft (100 m)	492 ft (100 m)	492 ft (100 m)	492 ft (100 m)	NA
Total Corridor Width for Export Cable (assuming two cables) [f]	NA	3,280 ft (1,000 m)	NA	NA	NA	3,280 ft (1,000 m)	3,280 ft (1,000 m)	3,280 ft (1,000 m)	3,280 ft (1,000 m)	3,280 ft (1,000 m)	3,280 ft (1,000 m)	3,280 ft (1,000 m)	3,280 ft (1,000 m)	3,280 ft (1,000 m)	3,280 ft (1,000 m)	NA
Maximum Length of Inter-Link Cable	NA	6.2 mi (10 km)	NA	NA	NA	6.2 mi (10 km)	6.2 mi (10 km)	6.2 mi (10 km)	6.2 mi (10 km)	6.2 mi (10 km)	6.2 mi (10 km)	6.2 mi (10 km)	6.2 mi (10 km)	6.2 mi (10 km)	6.2 mi (10 km)	NA

Design Parameter	Air Quality	Water Quality	Terrestrial and Coastal Fauna	Birds	Bats	Coastal Habitat	Benthic Resources	Finfish, Invertebrates, and Essential Fish Habitat	Marine Mammals and Sea Turtles	Economics and Environmental Justice	Cultural, Historical, and Archaeological Resources	Recreation and Tourism	Commercial Fisheries and For-Hire Commercial Fishing	Land Use and Coastal Infrastructure	Navigation and Vessel Traffic	Other Uses
Export Cable Installation Method (includes a pre-lay grapnel run)	NA	Dredging the entire route	NA	Dredging the entire route	NA	Dredging the entire route	Dredging the entire route	Dredging the entire route	Dredging the entire route	Dredging the entire route	Dredging the entire route	Dredging the entire route	Dredging the entire route	Dredging the entire route	Dredging the entire route	NA
Export Cables Dredging (width corridor per cable)	NA	66 ft (20 m)	NA	66 ft (20 m)	NA	66 ft (20 m)	66 ft (20 m)	66 ft (20 m)	66 ft (20 m)	NA	66 ft (20 m)	NA	66 ft (20 m)	66 ft (20 m)	20 m (66 ft) wide corridor per cable	NA
Export Cables Total Dredging Area	NA	up to 69 acres (0.28 km^2)	NA	up to 69 acres (0.28 km^2)	NA	up to 69 acres (0.28 km^2)	up to 69 acres (0.28 km^2)	up to 69 acres (0.28 km^2)	up to 69 acres (0.28 km^2)	NA	up to 69 acres (0.28 km^2)	NA	up to 69 acres (0.28 km^2)	up to 69 acres (0.28 km^2)	up to 279,400 m2 (69 acres)	NA
Export Cables Total Dredging Volume	NA	up to 214,500 cy (164,000 m^3)	NA	up to 214,500 cy (164,000 m^3)	NA	up to 214,500 cy (164,000 m^3)	up to 214,500 cy (164,000 m^3)	up to 214,500 cy (164,000 m^3)	up to 214,500 cy (164,000 m^3)	NA	up to 214,500 cy (164,000 m^3)	NA	up to 214,500 cy (164,000 m^3)	up to 214,500 cy (164,000 m^3)	up to 214,500 cy (164,000 m^3)	NA
Protection Method (rock placement, concrete mattresses, half-shell)	NA	Up to 10% of export route	NA	Up to 10% of export route	NA	Up to 10% of export route	Up to 10% of export route	Up to 10% of export route	Up to 10% of export route	Up to 10% of export route	Up to 10% of export route	Up to 10% of export route	Up to 10% of export route	Up to 10% of export route	Up to 10% of export route	NA
Onshore Components																
Landfall Locations	Evaluate all traffic	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed, including listed species, for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed, including listed species, for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed, including listed species, for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed, including listed species, for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	NA
Landfall Transition Method	NA	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed, including listed species, for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed, including listed species, for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed, including listed species, for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed, including listed species, for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	NA
Landfall Transition	NA	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	Both landfall locations need to be reviewed, including listed species, for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed, including listed species, for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed, including listed species, for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	Both landfall locations need to be reviewed for impacts and compliance with applicable federal and state regulations	NA

Design Parameter	Air Quality	Water Quality	Terrestrial and Coastal Fauna	Birds	Bats	Coastal Habitat	Benthic Resources	Finfish, Invertebrates, and Essential Fish Habitat	Marine Mammals and Sea Turtles	Economics and Environmental Justice	Cultural, Historical, and Archaeological Resources	Recreation and Tourism	Commercial Fisheries and For-Hire Commercial Fishing	Land Use and Coastal Infrastructure	Navigation and Vessel Traffic	Other Uses
Onshore Construction Location	NA	NA	NA	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	NA	NA	NA	NA	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	NA
Onshore Dimensions	NA	NA	NA	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	NA	NA	NA	NA	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	NA
Onshore Export Cable Route	NA	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	NA		NA	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations		Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	NA
Length of Onshore Cable	NA	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed, including listed species, for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	NA	NA	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	NA
Onshore Substation Site Location	NA	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed, including listed species, for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	NA	NA	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	Both upland routes need to be reviewed for impacts and compliance with applicable federal and state regulations	NA	NA

AIS = Automatic identification system; BOEM = Bureau of Ocean Energy Management; cy = cubic yard; DP = dynamic positioning; ESP = electrical service platform; FAA = Federal Aviation Administration; ft = foot; ft^2 = square feet; kJ = kilojoule; km = kilometer; kV = kilovolt; m = meter; m^2 = square meters; m^3 = cubic meters; mi = mile; MLLW = mean lower low water; MW = megawatt; NA = not applicable; nm = nautical mile; USCG = United States Coast Guard; WTG = wind turbine generator

[a] Vineyard Wind's Proposed Action is for an approximately 800 MW offshore wind energy project. This SEIS evaluates the potential impacts of a facility up to 800 MW to ensure that it covers projects constructed with a smaller capacity.

[b] Additional positions allow for spare turbine locations or additional capacity to account for electrical losses.

[c] Elevations relative to mean higher high water are approximately 3 feet (1 meter) lower than those relative to MLLW.

[d] Work would not be performed concurrently. No drilling is anticipated; however, it may be required if a large boulder or refusal is met. If drilling is required, a rotary drilling unit would be mobilized or vibratory hammering would be used. Similarly, vibratory hammering could be used if deemed appropriate by the installation contractor.

[e] Vineyard Wind has estimated that typical pile driving for a monopile is expected to take less than approximately 3 hours to achieve the target penetration depth and that pile driving for the jacket foundation would take approximately 3 hours to achieve the target penetration depth. The hammer size used for installation of the monopile and jacket foundation differs.

[f] Corridor width for siting purposes; each trench would be approximately 3.2 feet (1 meter) wide and there would be an up to 3.3-6.6 feet (1-2 meter) wide temporary disturbance zone from the tracks or skids of the cable installation. Corridor width for siting purposes; each trench would be approximately 3.2 feet (1 meter) wide and would directly disturb an approximately 6.4-foot (2-meter) wide corridor.

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APPENDIX F

Distribution List

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APPENDIX F. DISTRIBUTION LIST

Cooperating Federal Agencies

U.S. Department of the Interior, Bureau of Safety and Environmental Enforcement
Cheri Hunter, Sterling, Virginia

U.S. Coast Guard
George Detweiler, Washington, District of Columbia
Michele DesAutels, Boston, Massachusetts
Moon Youngmee, E. Providence, Rhode Island

U.S. Army Corps of Engineers
Christine Jacek, Concord, Massachusetts

U.S. Environmental Protection Agency
Tim Timmermann, Boston, Massachusetts

National Oceanic and Atmospheric Administration, National Marine Fisheries Service
Sue Tuxbury, Gloucester, Massachusetts

Narragansett Indian Tribe
John Brown, Charlestown, Rhode Island

Participating Federal Agencies

Federal Aviation Administration
Cindy Whitten, Kansas City, Missouri

National Park Service
Mary Krueger, Boston, Massachusetts

U.S. Fish and Wildlife Service
Tom Chapman, Concord, New Hampshire

Cooperating State Agencies

Massachusetts Coastal Zone Management
Bob Boeri, Boston, Massachusetts
Todd Callaghan, Beverly, Massachusetts

Rhode Island Coastal Resource Management Council
Jeffrey Willis, Wakefield, Rhode Island

Rhode Island Department of Environmental Management
Janet Coit, Providence, Rhode Island

Tribes and Native Organizations

Connecticut
Mashantucket (Western) Pequot Tribal Nation
Mohegan Tribe of Indians of Connecticut

Massachusetts
Mashpee Wampanoag Tribe
Wampanoag Tribe of Gay Head (Aquinnah)

New York
Shinnecock Indian Nation

Rhode Island
Narraganset Indian Tribe

Libraries

Massachusetts
Aquinnah Public Library, Aquinnah
Boston Public Library, Boston
Chilmark Free Public Library, Chilmark
Edgartown Public Library, Edgartown
Hyannis Public Library, Hyannis
New Bedford Free Public Library, New Bedford
Oak Bluffs Public Library, Oak Bluffs
Nantucket Atheneum, Nantucket
Vineyard Haven Public Library, Vineyard Haven
West Tisbury Free Public Library, Vineyard Haven
Woods Hole Public Library, Woods Hole

Rhode Island
Maury Loontjens Memorial Library, Narragansett

Other Interested Parties

Martha's Vineyard Commission, Oak Bluffs
Massachusetts Historic Commission
Town and County of Nantucket
Town of Barnstable
Town of Tisbury
Town of Yarmouth

Commenters on Draft EIS[1]

Al Eagles
Alan and Kristi Strahler
Alden Lenhart
Alessandro Bocconcelli
Alex Kithes
Alex Papali, Clean Water Action
Alice Berlow
Amanda Braga, Marion Institute
Amber Hewett, National Wildlife Federation

[1] BOEM was not able provide a copy of the EIS to commenters who did not provide a mailing address.

Andrew Grande, Massachusetts Climate Action Network
Ann Howe
Ann Rosenkranz, 350 Martha's Vineyard Island
Anne Hawkins, Responsible Offshore Development Alliance
Annie Hayes
Ara Charder
Audra Parker
Audrey Ciochetto
Ben Hellerstein, Environment Massachusetts Research and Policy Center
Beth Casoni, Massachusetts Lobstermen's Association
Bethia Brehmer
Bill Lake
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APPENDIX H

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The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the sound use of our land and water resources, protecting our fish, wildlife and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island communities.

The Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management (BOEM) works to manage the exploration and development of the nation's offshore resources in a way that appropriately balances economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.