New England Wind 2 Connector

Supplemental Analysis to Support Petition Before the Energy Facilities Siting Board

Docket #EFSB 22-06

May 12, 2023

Submitted by
Commonwealth Wind, LLC
125 High Street, 6th Floor
Boston, MA 02110

Submitted to
Energy Facilities Siting Board
One South Station
Boston, MA 02114

Prepared by
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In Association with
Foley Hoag LLP
Stantec, Inc.
Geo SubSea LLC
Public Archaeology Laboratory

AVANGRID Offshore Wind

May 12, 2023

Mr. Andrew Greene, Director
Energy Facilities Siting Board
One South Station
Boston, MA 02110

Subject: **New England Wind 2 Connector**
Supplemental Filing

Dear Mr. Greene:

Commonwealth Wind, LLC, a wholly owned subsidiary of Avangrid Renewables, LLC, (the "Company") is pleased to submit this Supplemental Filing to update the Section 69J Petition (Petition) for the New England Wind 2 Connector (the "Project") which was submitted to the Energy Facilities siting Board on November 1, 2022. The Project will transmit offshore wind energy output from the Commonwealth Wind Project, an offshore wind project located within Lease Area OCS-A0534 in federal waters under the jurisdiction of the Bureau of Ocean Energy Management (BOEM).

Since the initial filing in November, updates have been made to the design of the proposed new onshore Project substation off Oak Street. The supplemental filing includes visual and noise analyses and an updated stormwater management report which reflect the design revisions. Additionally, the Company conducted an assessment of the electric and magnetic field (EMF) for the offshore and onshore export cables. The Company also performed additional evaluations for the three grid interconnection route options presented in the initial Analysis which has now led to the selection of the Preferred and Noticed Alternative Grid Interconnection Routes. In addition, the Supplemental Filing provides an update regarding the Power Purchase Agreements for the electricity generated by the offshore wind energy generation facility.

Finally, the Company would like to make the Board aware that BOEM published the Notice of Availability (NOA) for the New England Wind Draft Environmental Impact Statement (DEIS), on December 23, 2022. A copy of the DEIS is being submitted simultaneously with this filing as Attachment 1.

Sincerely,

Kenneth L. Kimmell
Vice President of Development for Offshore Wind

Enclosures

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List of Acronyms

AC	alternating current
ACECs	Areas of Critical Environmental Concern
AUL	Activity and Use Limitation
BMPs	Best Management Practices
BOEM	Bureau of Ocean Energy Management
BVW	Bordering Vegetated Wetland
BWSC	Bureau of Waste Site Cleanup
CCC	Cape Cod Commission
CGP	Construction General Permit
CPUE	catch per unit effort
dB	decibel
DC	direct current
DCR	Massachusetts Department of Conservation and Recreation
DEIS	Draft Environmental Impact Statement
Department	Massachusetts Department of Public Utilities
EDCs	Massachusetts Electric Distribution Companies
EFSB or Board	Energy Facilities Siting Board
EMF	electric and magnetic field
EPA	U.S. Environmental Protection Agency
EPC	Engineering, Procurement and Construction
GIS	Gas Insulated Substation
HCA	Host Community Agreement
HDD	horizontal directional drilling
HVAC	high voltage alternating current
HVDC	high voltage direct current
Hz	hertz
ICNIRP	the International Commission on Non-Ionizing Radiation Protection
Inventory	Inventory of Historic and Archaeological Assets of the Commonwealth
IVW	Isolated Vegetated Wetlands
IWPA	Interim Wellhead Protection Area
L_{90}	sound level exceeded 90 percent of the time
L_{eq}	sound equivalent level
LID	Low Impact Development
LOS	line-of-sight
LSF	Lands Subject to Flooding
MACRIS	Massachusetts Cultural Resource Information System
MassDEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
MassGIS	Massachusetts Geographical Information System
MCP	Massachusetts Contingency Plan

List of Acronyms (Continued)

MF	magnetic field
mG	milligauss
MHC	Massachusetts Historical Commission
MW	megawatts
NCEI	National Centers for Environmental Information
NE Wind 2 Connector	New England Wind 2 Connector
NHESP	MassWildlife's Natural Heritage & Endangered Species Program
NIEHS	National Institute of Environmental Health Sciences
NOA	Notice of Availability
NPDES	National Pollutant Discharge Elimination System
NR	National Register of Historic Places
NWS	National Weather Service
OECC	Offshore Export Cable Corridor
ORW	Outstanding Resource Waters
OSW	offshore wind
PCBs	polychlorinated biphenyls
PL	property line
PMP	Probable Maximum Precipitation
PPA	Power Purchase Agreement
RFA	Riverfront Area
RMAT	Resilient Massachusetts Action Team
ROW	Right-of-Way
SEER	U.S. Offshore Wind Synthesis of Environmental Effects Research
SHLO	state highway layout
SLM	sound level meter
SR	State Register of Historic Places
STATCOM	Static Synchronous Compensator
SWPPP	Stormwater Pollution Prevention Plan
TJB	transition joint bay
WHO	World Health Organization
WPA	Wetland Protection Act
ZVI	Zone of Visual Influence

Section 1.0

Introduction

1.0 INTRODUCTION

Commonwealth Wind, LLC, a wholly owned subsidiary of Avangrid Renewables, LLC, (collectively, "the Company") is filing this Supplement to its Analysis to Support Petition Before the Energy Facilities Siting Board ("the Board" or "EFSB") (Attachment A to Petition) for the New England Wind 2 Connector (the "Project" or "NE Wind 2 Connector") which will transmit approximately 1,200 megawatts (MW) of the Commonwealth Wind Project's output. The purpose of this Supplement is to inform the Board of the Project changes that have been made since the filing of the Petition as well as the results of additional engineering and environmental analyses.

First, updates have been made to the design of the proposed new onshore Project substation off Oak Street. This Supplement includes visual and noise analyses which reflect the design revisions. Second, the Company updated the stormwater management report for the onshore Project substation to reflect the design revisions. Third, the Company assessed the electric and magnetic field (EMF) for the offshore and onshore export cables. Fourth, the Company performed additional evaluations for the three grid interconnection route options presented in the Analysis which has now led to the selection of the Preferred and Noticed Alternative Grid Interconnection Routes. Fifth, the Company is providing an update regarding the Power Purchase Agreements for the electricity generated by the offshore wind energy generation facility known as Commonwealth Wind located within Lease Area OCS-A 0534 in federal waters under the jurisdiction of the Bureau of Ocean Energy Management (BOEM) off the coast of Massachusetts (see Figure 1-1). Finally, the Company would like to make the Board aware that BOEM published the Notice of Availability (NOA) for the New England Wind Draft Environmental Impact Statement (DEIS), on December 23, 2022.[1] A copy of the DEIS is being submitted simultaneously with this filing as Attachment 1.

This Supplement is organized as follows:

- Section 2.0 and Attachments 2 and 3 include a description of updates related to the onshore substation including updated engineering plans and stormwater management report since the November 1, 2022 filing.
- Section 3.0 and Attachment 4 include a detailed EMF analysis for the offshore and onshore transmission cables.
- Section 4.0 and Attachment 5 include additional analysis of the three grid interconnection route options and selection of Preferred and Noticed Alternative Grid Interconnection Routes.
- Section 5.0 and Attachments 6, 7, and 8 include a noise analysis for the revised onshore substation design.
- Section 6.0 and Attachment 9 include a visual analysis of the revised onshore substation design.
- Section 7.0 includes an update regarding the Project's Power Purchase Agreements.

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[1] New England Wind includes two phases: At a minimum, Phase 1 includes Park City Wind and Phase 2 includes Commonwealth Wind.

G:\Projects2\MA\MA\6470\Task_2.1\EFSB_Supplement1\MXD\1-1_Project_Overview_20230109.mxd

Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

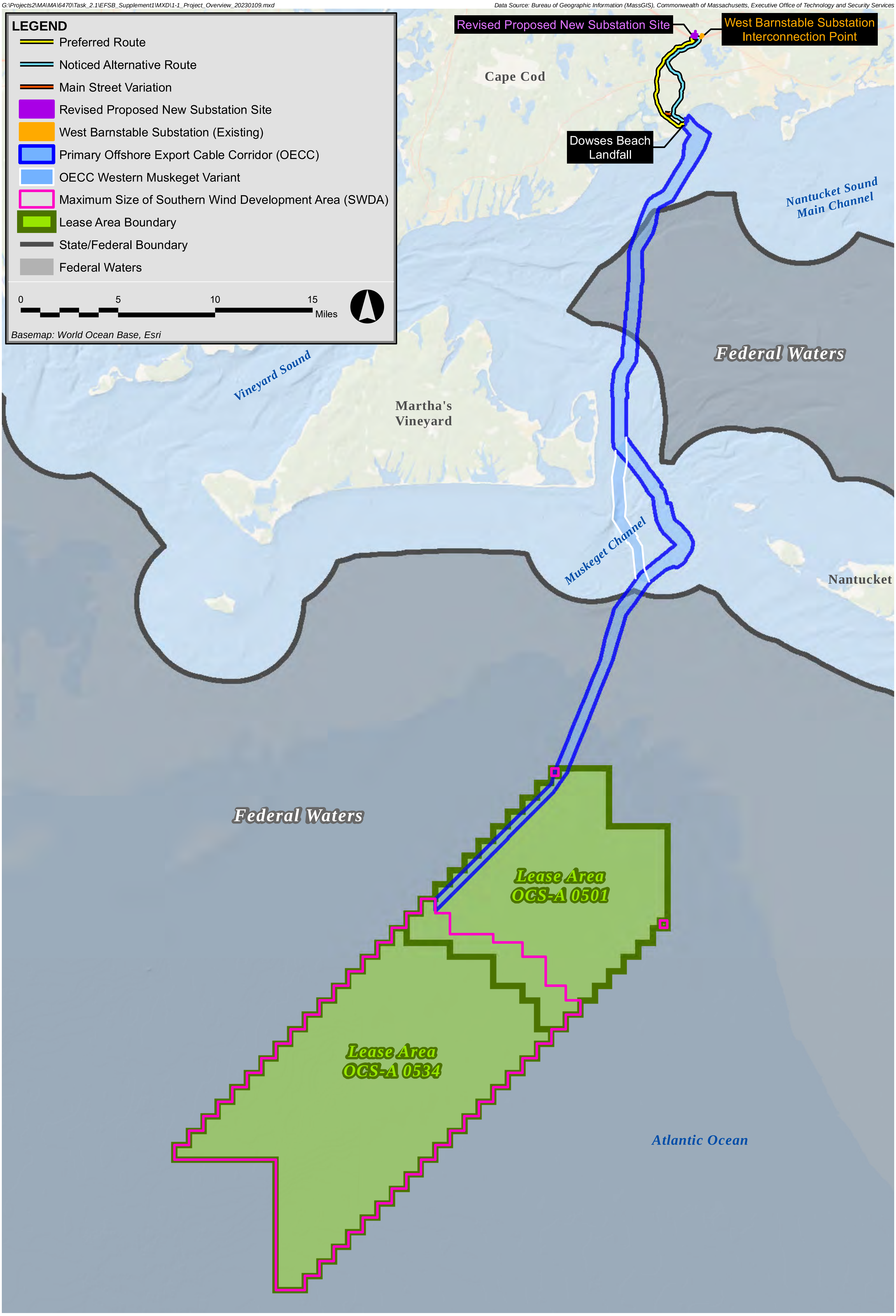


Figure 1-1

Project Overview

Section 2.0

Revised Onshore Substation

2.0 REVISED ONSHORE SUBSTATION

2.1 Revised Onshore Substation Description

The Project requires a new onshore substation to step up power from 275-kV to 345-kV for interconnection with the regional power grid at the existing 345-kV West Barnstable Substation.

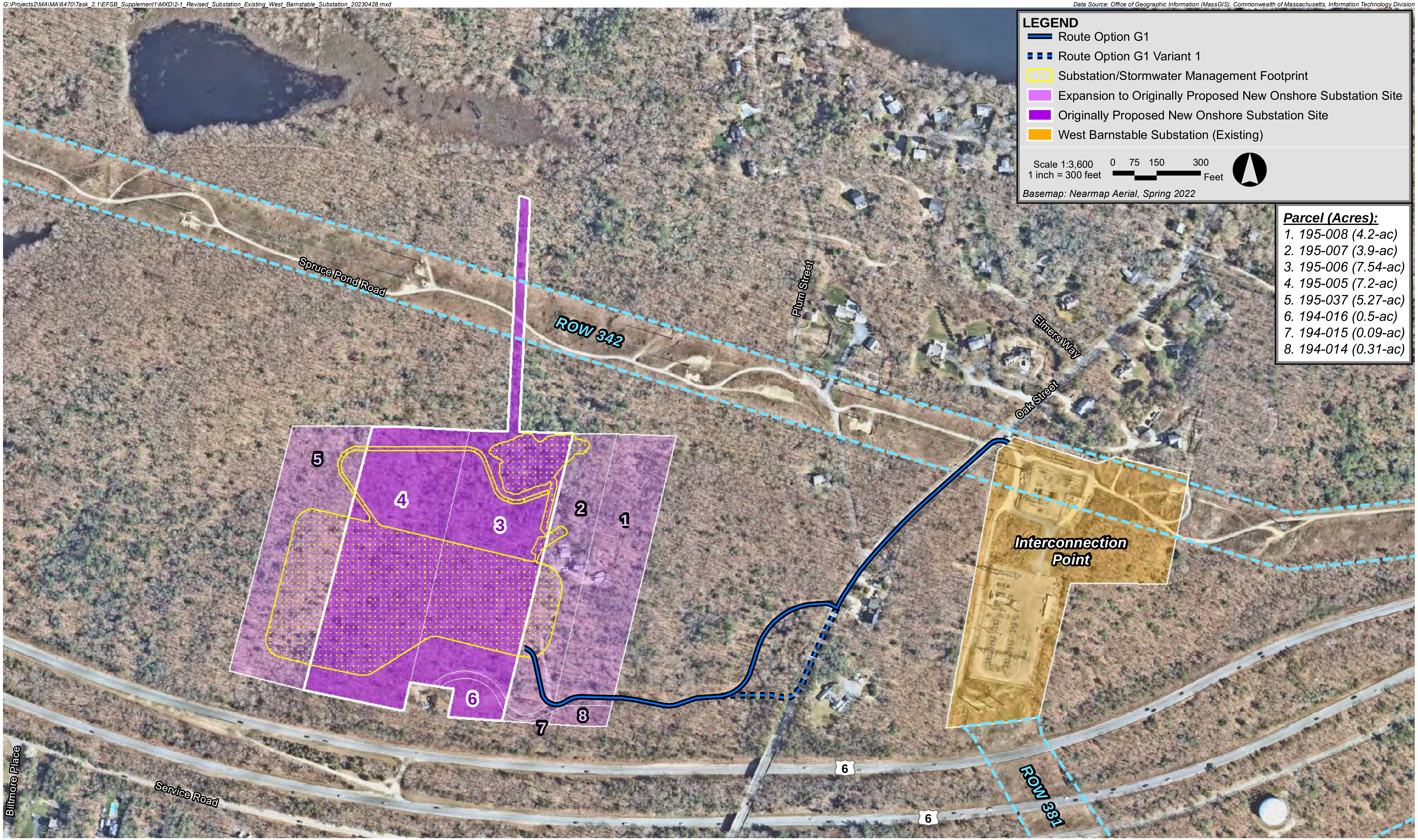
As described in Analysis Section 1.1, the Project's proposed new onshore substation is located west of Oak Street near the Oak Street Bridge overpass of Route 6, approximately 0.25 mile west of the interconnection location at the existing Eversource West Barnstable Substation. The original new onshore substation site was proposed on three wooded contiguous privately owned parcels totaling approximately 15.24 acres (Parcels 195-005, 195-006, and 194-016) (see Figure 2-1), of which two would be utilized for substation development. The location of the new onshore substation has not changed; however, the Company now has site control over eight contiguous privately owned parcels totaling approximately 29.01 acres, which allows the Company to optimize the layout of the substation and obtain additional rights along the Fire Tower Access Road. Figure 2-1 identifies all eight privately-owned parcels for which the Company has site control (the new parcels are identified in a lighter shade). Of the eight parcels, four of the parcels (Parcels 195-007, 195-006, 195-005, and 195-037) will be developed with the new revised onshore substation. Specifically, compared to the original design presented in the Analysis (see Analysis Attachment B4), the revised substation design (see Attachment 2) has the following benefits:

- Largely designed with the existing terrain in an east-west direction to minimize the amount of earth material movement;
- Eliminates the need for retaining walls with significant heights around the entire perimeter of the substation as well as retaining walls along the stormwater attenuation basin access road, reducing the overall duration for substation construction and potential for visual impacts (see Analysis Attachment B4);
- Maintains additional existing forested buffer around the substation (see Attachment 2, Drawing Sheet 8, and Analysis Attachment B4, Drawing Sheet 7); and
- Utilizes the parcel of the closest residential receptor, who will no longer reside there.

The revised proposed new onshore substation will be sited primarily in the southern and central portions of the four parcels that will be developed (see Attachment 2 and Figure 2-1). Of the four parcels to be developed, two of the parcels are undeveloped wooded lots, a third parcel has minor cleared areas and an existing access road/driveway, with the fourth parcel developed with a single-family residence. The approximate 4.20-acre parcel (Parcel 195-008) located closest to Oak Street will remain undeveloped; however, existing cleared areas within this parcel may be used during construction for temporary construction parking, trailers, or staging and laydown, while

G:\Projects2\MA\MA\6470\Task_2.1\EFSB_Supplement1\MXD\2-1_Revised_Substation_Existing_West_Barnstable_Substation_20230428.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



New England Wind 2 Connector Project

AVANGRID Offshore Wind

Figure 2-1

Proposed New Onshore Substation Site and Existing West Barnstable Substation – Aerial Locus the existing access road/driveway will also be improved (widened and graded with gravel surface) to support construction and the Preferred Grid Interconnection Route. The three small parcels located south of the existing Fire Tower Access Road and east of the existing Massachusetts Department of Conservation and Recreation (DCR) Fire Tower (see Figure 2-1 Parcels 6, 7, and 8) will also remain undeveloped.

Surrounding land uses are consistent with that described in Section 1.3.4 of the Analysis and include the DCR Fire Tower parcel and Route 6 State Highway Layout (SHLO) managed by the Massachusetts Department of Transportation (MassDOT) to the south. To the west, the proposed substation parcels are bordered by undeveloped Article 97-protected land owned by the Town of Barnstable and managed by the Conservation Commission. To the north, the site, including a 40-foot-wide "panhandle," partially occupied by a clearcut electrical easement that extends from the north of Parcel 195-006, is bordered by Article 97-protected parcels that are part of the Spruce Pond Conservation Area owned by the Town of Barnstable and managed by the Conservation Commission and Falcon Road Conservation Area. The existing Eversource right-of-way (ROW) #342 and Spruce Pond Road are located in the Spruce Pond Conservation Area. To the east, the site is also bordered by Article 97-protected land (Kuhn Property) owned by the Town of Barnstable and managed by the Conservation Commission.

The proposed substation parcels are located in a residentially zoned area as well as an Aquifer Protection Overlay District. There are no mapped wetlands on or within 100 feet of the revised substation site or perennial streams on or within 200 feet. The eight substation parcels are mapped as a Potential Public Water Supply Area by the Cape Cod Commission (CCC).

Table 2-1 below provides a summary of the proposed original and revised onshore substation parcels.

Table 2-1 Summary of Proposed Original and Revised Onshore Substation Parcels

Parcel # (Figure 2-1)	*Parcel ID*	*Parcel Size [a] (acres)*	*Original Onshore Substation Site*	*Revised Onshore Substation Site*	*Original Site To Be Developed [b]*	*Revised Site To be Developed [c]*
1.	195-008	4.20		X		
2.	195-007	3.90		X		X
3.	195-006	7.54	X	X	X	X
4.	195-005	7.20	X	X	X	X
5.	195-037	5.27		X		X
6.	194-016	0.50	X	X		
7.	194-015	0.09		X		
8.	194-014	0.31		X		

a. Town of Barnstable Property Maps (https://gis.townofbarnstable.us/Html5Viewer/Index.html?viewer=propertymaps)

b. See Analysis Attachment B4 for additional detail on area to be developed.

c. See Attachment 2 for additional detail on area to be developed.

The four parcels that will be developed for the new revised onshore substation will be partially cleared as a result of Project development. Land and tree clearing will be minimized to the extent practicable. The existing single-family residence will also be removed. Table 2-2 provides a summary comparison of the areas to be developed for the proposed original and revised onshore substation.

Table 2-2 Summary Comparison of Area to be Developed under the Proposed Original and Revised Onshore Substation Designs

	Original Design (acres)	*Revised Design (acres)*
Total Proposed Disturbance Area	12.4	13.6

(1) Of the total 13.6 acres of disturbance proposed for the revised onshore substation design 13.3 acres requires the clearing of forested lands.

As outlined in Table 2-2, the revised onshore substation design will result in approximately 1.2 acres more of overall disturbance when compared to the original onshore substation design. However, the revised design eliminates the need for retaining walls with significant heights around the entire perimeter of the substation as well as retaining walls along the stormwater access road and provides additional maneuverability within the substation fenceline. The total impervious area following substation construction is consistent across the two designs (approximately 2.8 acres).

2.2 Revised Stormwater Management

The revised stormwater management design for the revised onshore substation is consistent with the original stormwater management design goals. The stormwater management design will meet or exceed the Massachusetts Stormwater Policy recommendations and the Project will comply with Massachusetts Department of Environmental Protection (MassDEP) Stormwater Standards. In addition, the stormwater management system has been designed in consideration of the Resilient Massachusetts Action Team (RMAT) Design Standards and Guidelines. The stormwater management system has been designed to accommodate the 24-hour storm event (2-year, 10-year, 50-year (RMAT), and 100-year) using Extreme Precipitation Estimates from the Northeast Regional Climate Center.

Consistent with the stormwater management design for the original substation, the proposed stormwater management system for the revised new onshore substation incorporates the same low impact development (LID) strategies in addition to a rip-rap-lined channel down a steep slope to the infiltration basin which consists of an existing natural depression. The LID strategies are designed to capture, treat, and recharge stormwater runoff. These measures provide a treatment train to improve the quality of stormwater runoff, reduce the quantity of stormwater runoff, and provide infiltration and recharge to groundwater. These are considered Best Management Practices (BMPs) by MassDEP. See Attachment 3 Section 1.5 for a summary of the LID measures to be incorporated.

Post-development stormwater will substantially infiltrate on-site because the substation yard surface will be predominantly permeable (e.g., proposed crushed stone yard), with well-drained soils underneath. However, during extreme rainfall events, rainfall and runoff from impermeable surfaces on the site may briefly exceed the infiltration capacity of the underlying soil beneath the crushed stone surfacing and will instead flow into the site drainage system. The proposed drainage plan and sub-catchment areas are depicted in Sheets 7 (Proposed Grading and Drainage Plan) and 8 (Proposed Subcatchment Areas) of Attachment 2. As the substation design and Site Plan are refined, the Project Stormwater Management Plan will be adjusted accordingly to reflect any hydraulic or hydrologic changes or BMP changes that might result from Site Plan revision.

Prior to construction, the Project will also obtain coverage under the National Pollutant Discharge Elimination System (NPDES) Construction General Permit for Stormwater Discharges from Construction Activities (CGP) from the U.S. Environmental Protection Agency (EPA). A draft Erosion & Sediment Control Plan is included in Attachment 3 Section 3. A Stormwater Pollution Prevention Plan (SWPPP) will be developed and maintained that will identify controls to be implemented to mitigate the potential for erosion and sedimentation from soil disturbance during construction. An Operations and Maintenance Plan for Proposed Stormwater BMPs will also be prepared as part of final design.

The Stormwater Management Report for the 275/345 KV Substation is provided in Attachment 3.

2.3 Containment System

The proposed onshore substation site is located within a Potential Public Water Supply Area mapped by the CCC. The revised onshore substation design continues to include extensive containment measures for the revised substation design. None of the substation equipment will contain polychlorinated biphenyls (PCBs). The Company will provide full-volume (110%) containment systems for major substation components using dielectric fluid (i.e., the main transformers, iron core reactors, and equipment containing dielectric fluid associated with the STATCOMS, as applicable). While sumps for transformers are standard practice, they are not normally used for other lower-volume fluid-filled equipment given the low probability of any leakage. However, the Company will commit to this additional containment above and beyond standard practices given the sensitive nature of the Cape Cod watershed. The containment sumps will be designed to fully contain the dielectric fluid in the very unlikely event of a complete, catastrophic failure of the transformer or other equipment.

In addition, as the developers of the Vineyard Wind Connector 1 and NE Wind 1 Connector have committed to doing pursuant to their Host Community Agreements (HCAs) with the Town of Barnstable, the Company expects to commit, as part of an HCA agreement, to adding additional containment volume as follows. For substation components identified above (i.e., the main transformers, iron core reactors, and equipment containing dielectric fluid associated with the STATCOMS), in anticipation of an extreme rain event, the Company will increase the 110%

containment volume to account for the simultaneous Probable Maximum Precipitation (PMP) event in a 24-hour period, which will be determined for the substation site in consultation with the Town of Barnstable.

Also included in the design as additional mitigation is a common drain system that routes each individual containment area through an oil-absorbing inhibition device to an oil/water separator before draining to the infiltration basin.

Section 3.0

Electric and Magnetic Field Analysis

3.0 ELECTRIC AND MAGNETIC FIELD ANALYSIS

3.1 Electric And Magnetic Field Introduction

Since the filing of the Petition, an assessment of the electric and magnetic field (EMF) levels associated with the NE Wind 2 Connector was completed by Gradient. EMFs associated with alternating current (AC) power transmission are at an extremely low frequency (60-hertz [Hz]) and are a low energy form of non-ionizing electromagnetic radiation. Power frequency EMFs are a form of "non-ionizing radiation," meaning power frequency EMF does not carry enough energy to break molecular bonds and damage DNA, biological cells, or tissues, and is not capable of even heating cells and tissues. The modeling analysis focused on magnetic fields (MFs) because the electric fields produced by the voltage on the export cables will be contained by the metallic sheathing and/or steel armoring of the cables- i.e., the metallic sheathing and/or steel armoring will completely shield the electric fields arising from the voltage on the cables. Magnetic fields are not completely shielded by either metallic sheathing or steel armoring, although the usage of ferromagnetic steel (e.g., galvanized steel) armoring can serve to partially attenuate the MFs found outside 3-phase 60-Hz alternating current cables (CSA Ocean Sciences Inc. and Exponent, 2019)[2].

In addition, burying the offshore and onshore transmission cables underground is a form of mitigation for EMFs because (1) underground lines produce no aboveground electric fields due to shielding by the underground duct banks and earth, and (2) the cable conductors can be placed closer together for underground cables than for overhead cables, which increases the degree of self-cancellation of magnetic fields.

Magnetic field modeling for both the offshore and onshore cables was performed using the Project's estimated approximately 1,200-MW output, including charging currents. This results in conservative calculations of magnetic field levels since the annual-average capacity factor of energy output for NE Wind 2 Connector is expected to be approximately 50%. The actual output and MF attributable to the Project cables will be correspondingly lower than predicted in this analysis, which assumes the offshore generation facility is operating continuously at its maximum output.

3.1.1 Human Exposure to EMF

A number of national and world health organizations have developed EMF exposure guidelines designed to be protective against adverse health effects. The limit values should not be viewed as demarcation lines between "safe" and "dangerous" levels of EMFs, but rather, levels that assure safety with an adequate margin of conservatism to allow for methodological variability as well as inter-individual variability. For magnetic fields, these health-based guidelines range from 1,000 to

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[2] CSA Ocean Sciences Inc.; Exponent. 2019. "Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England." Report to US Department of the Interior, Bureau of Ocean Energy Management (BOEM) OCS Study BOEM 2019-049. 62p., August.

10,000 milligauss (mG). The International Commission on Non-Ionizing Radiation Protection (ICNIRP) has also established a guideline for allowable public exposure to magnetic fields at 2,000 mG. As part of its International EMF Project, the World Health Organization (WHO) has conducted comprehensive reviews of EMF health-effects research and existing standards and guidelines. The WHO website for the International EMF Project (WHO, 2022)[3] notes, "[T]he main conclusion from the WHO reviews is that EMF exposures below the limits recommended in the ICNIRP international guidelines do not appear to have any known consequence on health."

For electrical appliances we use in our homes, typical EMFs nearby to the appliances can range from tens to >1,000 mG. For example, MF levels as high as 600 to 700 mG can be found 6 inches from hair dryers, vacuum cleaners, and electric shavers. Within 6 inches of a conventional electric range, MF levels can be as high as 200 mG, while MF levels higher in both intensity and frequency may be associated with induction cooktops.[4]

3.1.2 Marine Organism Exposure to EMF

No regulatory thresholds or guidelines for allowable EMF levels in marine environments have been established for either high voltage alternating current (HVAC) or high voltage direct current (HVDC) submarine power transmission.

For HVAC transmission, the weight of the scientific evidence indicates that 60-Hz AC EMF values are considerably above the typical frequency range of EMF values to which magnetosensitive and electrosensitive marine species are known to detect and respond. In particular, magnetosensitive marine species such as salmon, whales, and sea turtles are specifically tuned to the earth's steady (DC) geomagnetic field for navigation/migration purposes, while electrosensitive marine species such as sharks and rays primarily respond to electric field frequencies below 10 Hz for helping to locate prey and/or mates (CSA Ocean Sciences Inc. and Exponent, 2019).

A seven-year study, published in March 2022, reported the response of demersal fish (*i.e.*, fish living close to the sea floor) and invertebrates to construction and operation of an offshore wind (OSW) project (Wilber *et al.*, 2022)[5]. The study analyzed catch data from monthly demersal trawl surveys conducted by local fisherman and scientists during construction and operation of the 30-MW Block Island Wind Farm. The study did not identify harmful impacts of EMF from the project's 60-Hz AC submarine export cables or other offshore electrical infrastructure on local demersal fish and invertebrates, and instead reported evidence of increased populations of several fish

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[3] World Health Organization (WHO). 2022. "Radiation and health: Protection norms and standards." Accessed at https://www.who.int/teams/environment-climate-change-and-health/radiation-and-health/protection-norms.

[4] National Institute of Environmental Health Sciences (NIEHS). 2002. "Questions and Answers about EMF Electric and Magnetic Fields Associated with the Use of Electric Power." 65p., June.

[5] Wilber, DH; Brown, L; Griffin, M; DeCelles, GR; Carey, DA. 2022. "Demersal fish and invertebrate catches relative to construction and operation of North America's first offshore wind farm." ICES J. Mar. Sci. doi: 10.1093/icesjms/fsac051.

species near the wind farm during the operation time period relative to the reference areas. Statistically significant interactions in catch per unit effort (CPUE) due to operation of the wind farm were not observed for any of the fish species that were frequently caught in the surveys in the project and reference areas, including black sea bass (*Centropristis striata*), little skate (*Leucoraja erinacea*), summer flounder (*Paralichthys dentatus*), windowpane (*Scophthalmus aquosus*), winter flounder (*Pseudopleuronectes americanus*), winter skate (*Leucoraja ocellata*), and longfin squid (*Loligo pealeii*). These findings are consistent with those for European offshore wind farm projects. In a report to BOEM, CSA Ocean Sciences Inc. and Exponent (2019) provided the following summary of findings from fish surveys conducted in Europe in areas with offshore wind development:

> *Offshore wind energy projects, along with associated undersea power cables, have operated in coastal environments of Europe for more than a decade. During this time, many surveys have been conducted to determine if fish populations have declined following offshore wind energy project installation. The surveys have overwhelmingly shown that offshore wind energy projects and undersea power cables have no effect on fish populations [72,80,81,82]. Fish assessed as part of these surveys include flounder and other flatfish, herring, cod, and mackerel. These are similar to species harvested along the U.S. Atlantic coast.*

Earlier this year, as part of the U.S. Offshore Wind Synthesis of Environmental Effects Research (SEER) effort, researchers at the U.S. Department of Energy's Wind Energy Technologies Office, National Renewable Energy Laboratory, and Pacific Northwest National Laboratory published a Brief titled "Electromagnetic Field Effects on Marine Life" (SEER, 2022)[6]. This Brief was reviewed by external subject matter experts (Dr. Andrew Gill of the Centre for Environment, Fisheries, and Aquaculture Science; and Dr. Zoe Hutchison of the University of St. Andrews) and the SEER Science and Technical Advisory Committee. The Brief included the following summary of the overall state of the knowledge:

> *Overall, there is no conclusive evidence that EMFs from a subsea cable creates any negative environmental effect on individuals or populations. To date, no impacts interpreted as substantially negative have been observed on electrosensitive or magnetosensitive species after exposure to EMFs from a subsea cable. Behavioral responses to subsea cables have been observed in some species, but a reaction to EMFs does not necessarily translate into negative impacts. Continued research and monitoring are required to understand the ecological context within which short-term effects are observed and if species experience long-term or cumulative effects resulting from underwater exposure to EMFs. (SEER, 2022)*

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[6] US Offshore Wind Synthesis of Environmental Effects Research (SEER). 2022. "Electromagnetic Field Effects on Marine Life." 13p. Accessed on September 28, 2022 at https://tethys.pnnl.gov/sites/default/files/summaries/SEER-Educational-Research-Brief-Electromagnetic-Field-Effects-on-Marine-Life.pdf.

The Brief further concluded, "Overall, the effects of EMFs have been considered minor-to-negligible and a less significant issue than other environmental effects at OSW farms" (SEER, 2022). It discussed how factors such as cable burial depth, cable shielding, and the limited range of EMFs result in "a highly localized environmental condition that does not affect the entire habitat range for an animal" (SEER, 2022).

3.2 Offshore and Onshore Transition Magnetic Field Analysis

MF modeling was performed for a representative submarine cable cross section consisting of the three three-core 275-kV offshore export cables, each with a capacity of approximately 400 MW, buried to a depth of 4.9 ft (1.5 meters) beneath the seabed, corresponding to the lower limit of the target burial depth of approximately 5 to 8 ft (1.5 to 2.5 meters). The offshore export cables will be installed within an Offshore Export Cable Corridor (OECC) and will typically be separated by approximately 164 to 328 ft (50 to 100 meters). The minimum cable spacing of 164 ft (50 meters) was used in the MF modeling to capture any interaction of MF fields from adjacent cables at this minimum separation distance. The offshore cables will travel from the northwestern corner of the Lease Area to the Landfall site at the existing paved parking lot in Barnstable.

Modeling results showed the highest modeled MF levels of approximately 109 mG on the surface of the seafloor directly above the offshore export cables, with rapid reductions in MF levels with lateral distance away from the cable centerlines e.g., there is a >95% reduction in MF levels at a lateral distance of ±25 ft (±7.6 meters) from the cable centerlines. MF levels in the water column will be less than the modeled MF levels at the sea floor, with the rate of decrease in MF levels as a function of height above the cables being similar to the rate of fall-off as a function of distance laterally from the cables. Due to the rapid reductions in MF levels with lateral distance away from the cables, there is minimal interaction of MF from adjacent cables at the modeled minimum separation distance of 164 ft (50 meters). Table 3-1 summarizes MFs at the sea floor for buried submarine offshore export cables. Based on the localized nature of the MF impacts of the offshore export cables as well as the weight of the scientific evidence that 60-Hz AC EMFs are above the typical frequency range of EMFs to which magnetosensitive and electrosensitive marine species are known to detect and respond, there is no expectation that the modeled MFs, which assume 100 percent capacity of the wind farm, from the HVAC offshore export cables will cause significant population-level harms to marine species in the OECC.

Table 3-1 Modeled Magnetic Fields at the Sea Floor for Buried Submarine 275-kV Offshore Export Cables[a]

Cross Section	Predicted Resultant Magnetic Field (mG)		
	Maximum Directly Above Cable Centerline(s)	±10 ft (±3 m) from Outer Cables[b]	±25 ft (±7.6 m) from Outer Cables[b]
Buried Submarine Cables	109.4	24.7	5.0

Notes: ft = Foot; kV = Kilovolt; m = Meter; mG = Milligauss.

a. The offshore export cable MF modeling assumes straight-laid phase-conductor cable cores rather than helical or "twisted" phase-conductor cores (the expected cable design). As discussed in Attachment 4, Section 3.2, field measurements taken for the Block Island "sea2shore" cable show that a helical design achieves a considerable degree of magnetic field cancellation, hence the modeled MF levels are expected to be overestimates of actual MF levels at maximum wind farm output.

b. The values provided at lateral distances of 10 and 25 ft are for 10 and 25 ft from the outer cables. Only one value is presented for each lateral distance because the predicted results for the left and right of the cables are identical.

Modeling of the offshore export cables was also performed for cross sections representative of two locations along the three Horizontal Directional Drilling (HDD) paths to be constructed for bringing the cables ashore to the Parking Lot Landfall site in Barnstable, including: (1) a middle-of-the beach cross section representative of where the cables will pass under the beach with burial depths to the tops of the cables that range from 24.7 to 57.4 ft (7.5 to 17.5 meters) for the three HDD paths; and (2) a parking lot cross section representative of the cables beneath the paved parking lot where the depths to the tops of the cables are 5 to 6 ft (1.5 to 1.8 meters) for the three HDD paths leading to the underground transition vaults/joint bays. Separate modeling cases were performed for the southernmost HDD path (referred to as HDD1), which will land in the southern portion of the parking lot with a minimum separation distance of 328 ft (100 meters) from the other HDD paths; and for the other two HDD paths (referred to as HDD2 and HDD3), which will make landfall along the northern portion of the parking lot in closer proximity to each other (see Analysis Attachment B1, Drawing Sheet 3 - HDD Overall Plan).

Maximum modeled MFs of 5.0 and 1.0 mG were obtained at the ground surface directly above the offshore export cables for the two HDD modeling scenarios for the middle-of-the-beach location. For the parking lot location where the HDD paths are closer to the ground surface, maximum modeled MFs were 41.4 and 32.7 mG at one meter above the ground surface directly above the offshore export cables. For the parking lot cross section, modeled MFs were found to drop off very rapidly with lateral distance from the cables, with reductions in MF levels of between 85 to 90% for a lateral distance of 25 ft on either side of the cable centerlines. Table 3-2 summaries modeled MFs for the HDD paths. All modeled MF levels for the landfall site cross sections were far below the ICNIRP health-based guideline of 2,000 mG for allowable public exposure to 60-Hz AC MFs. This is the case despite modeled MF levels for the 275-kV offshore export cables being overestimates of the expected MF levels for actual Project operations due to several conservative assumptions in the modeling analysis, including not accounting for the expected twisting of the conductors within the cables that will contribute to substantially greater self-cancellation of MF than for straight conductors, and the use of cable currents based on maximum wind farm output (100 percent capacity).

The three cores within the cables are to be helically wound, where the phase conductors would have a "twisted" design rather than being straight and parallel over long distances. This twisting of the conductors is expected to contribute to substantially greater self-cancellation of MF than predicted from the modeling analysis that assumes continuously straight conductors, although less than the cancellation associated with the triangular geometry of the conductors (CSA Ocean Sciences Inc. and Exponent, 2019). This additional self-cancellation from the twisting of the phase conductors is not typically reflected in MF modeling analyses of submarine cables due to the complexity of modeling it. It has been estimated for the 30-MW 60-Hz AC "sea2shore" cable, which was commissioned in 2016 to connect the Block Island wind energy project with the Rhode Island mainland grid, that the helical twisting of the three-phase cable reduced MF levels by at least 10-fold as compared to an untwisted three-phase cable (CSA Ocean Sciences Inc. and Exponent, 2019; Hutchison et al., 2018).[7]

Table 3-2 Modeled Magnetic Fields for the 275-kV Offshore Export Cables Along the Horizontal Directional Drilling (HDD) Paths at the Dowses Beach Landfall Site[a]

Cross Section	Predicted Resultant Magnetic Field (mG)		
	Maximum Directly Above Cable Centerline(s)	±10 ft (±3 m) from Reference Point[c]	±25 ft (±7.6 m) from Reference Point[c]
Landfall, Middle of Dowses Beach[b]			
HDD1(South)	5.0	4.3	2.5
HDD2 (Center)/HDD3 (North)	1.0	1.0	0.9
Landfall, Parking Lot Behind Dowses Beach[b]			
HDD1(South)	41.4	17.9	4.5
HDD2(Center)/HDD3(North)	32.7	16.1	4.7

Notes: ft = Foot; m = Meter; mG = Milligauss.

a. The offshore export cable MF modeling assumes straight-laid phase-conductor cable cores rather than helical or "twisted" phase-conductor cores (the expected cable design). As discussed in Attachment 4, Section 3.2, field measurements taken for the Block Island "sea2shore" cable show that a helical design achieves a considerable degree of magnetic field cancellation, hence the modeled MF levels are expected to be overestimates of actual MF levels at maximum wind farm output.

b. Magnetic fields are modeled at the ground surface for the middle-of-beach cross section, and at 3.28 ft (1 m) above ground surface for the parking lot cross section.

c. For HDD1, the values provided at lateral distances of 10 and 25 ft are with respect to the centerline of the cable. For HDD2 and HDD3, the values provided at lateral distances of 10 and 25 ft are for 10 and 25 ft from the outer cable. Only one value is presented for each lateral distance because the predicted results for the left and right of the cables are identical.

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[7] Hutchison, Z; Sigray, P; He, H; Gill, A; King, J; Gibson, C. 2018. "Electromagnetic Field (EMF) Impacts on Elasmobranch (shark, rays, and skates) and American Lobster Movement and Migration from Direct Current Cables." Report to US Department of the Interior, Bureau of Ocean Energy Management (BOEM) OCS Study BOEM 2018-003. 254p., March.

For a detailed discussion of magnetic fields and the offshore export cables, see Gradient Corporation's Magnetic Field Modeling Analysis Report (Attachment 4) at Section 3.

3.3 Onshore Magnetic Field Analysis

At the Parking Lot Landfall site, the three three-core 275-kV offshore export cables will transition to three sets of single-core 275-kV onshore export cables. The preferred onshore export cable route for the Project is located entirely underground within public roadway layouts and underneath the existing paved parking lot area at Dowses Beach and has a total length of approximately 6.7 miles. All three circuits will be installed in a single, common underground concrete duct bank along the entire length of the preferred onshore export cable route which will include a separate conduit for each onshore export cable and fiber optic cable. Spare conduits and grounding will also be accommodated within the duct bank resulting in a 3-wide-by-4-deep (3W×4D) array. See Analysis Attachment B, Sheet 26 for a typical cross-section of the conduit within the duct bank.

The following five representative onshore export cable installation scenarios and two representative grid interconnection cable installation scenarios are included in the MF analysis:

- Three 275-kV onshore export cable circuits arranged in a 3W×4D duct bank, buried 3.5 ft below ground surface (ft bgs) - referred to as the "typical" installation case for the 275-kV onshore export cables;
- Three 275-kV onshore export cable circuits arranged in a 3W×4D duct bank, buried seven ft bgs - referred to as the "deep" installation case for the 275-kV onshore export cables for crossing under utilities and other obstructions;
- Three 275-kV onshore export cable circuits installed in two 72-inch diameter microtunnels (two cables in one microtunnel and one cable in the other), spaced 80 ft apart from each other, for crossing under the Route 6 Highway;
- A single 275-kV onshore export cable circuit installed in a transition joint bay (TJB) to be located beneath the paved parking lot at Dowses Beach[8];
- A single 275-kV onshore export cable circuit installed in a splice vault and the other two 275-kV onshore export cable circuits installed in either a 2-wide-by-4-deep (2W×4D) bypass duct bank or in individual 1-wide-by-4-deep (1W×4D) bypass duct banks adjacent to the splice vault;
- Three 345-kV grid interconnection cable circuits arranged in a 3W×4D duct bank, buried 3.5 ft bgs - referred to as the "typical" installation case for the 345-kV grid interconnection cables; and

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[8] There is a single transition joint bay for each of the three onshore transmission circuits.

- Three 345-kV grid interconnection cable circuits arranged in a 3W×4D duct bank, buried seven ft bgs - referred to as the "deep" installation case for the 345-kV grid interconnection cables for crossing under utilities and other obstructions.

As shown in Table 3-3, all modeled MF levels for the 275-kV onshore export cables and the 345-kV grid interconnection cables are far below the ICNIRP health-based guideline of 2,000 mG. The results in Table 3-3 for modeled MF levels at different distances (±10 ft and ±25 ft) from the centerlines of the underground duct banks, transition joint bays, and splice vaults, and from the outer microtunnel for the Route 6 crossing, illustrate the significant reductions in MF with increasing lateral distance from the cables.

Table 3-3 Modeled Magnetic Fields at 3.28 ft (1 m) Above Ground Surface for Underground Onshore Export and Grid Interconnection Cable Installation Scenarios

Installation Scenario	Predicted Resultant Magnetic Field (mG)		
	Maximum Above Reference Point[a]	±10 ft (±3 m) from Reference Point[a]	±25 ft (±7.6 m) from Reference Point[a]
275-kV Onshore Export Cables			
3W×4D Duct Bank, Typical Installation	77.2	50.1 / 50.1	14.3 / 14.3
3W×4D Duct Bank, Deep Installation	83.4	59.8 / 59.8	21.8 / 21.8
Route 6 Crossing, 6-ft Microtunnel	38.8	30.2 / 18.8	13.9 / 5.2
Transition Joint Bay	96.9	50.2 / 49.1	14.1 / 13.8
Splice Vaults, Cross Section A	232.8	110.8 / 105.5	29.9 / 31.8
Splice Vaults, Cross Section B	121.3	68.7 / 28.2	11.6 / 4.2
Splice Vaults, Cross Section C	253.6	121.9 / 116.1	29.1 / 31.0
345-kV Grid Interconnection Cables			
3W×4D Duct Bank, Typical Installation	58.7	38.1 / 38.1	10.9 / 10.9
3W×4D Duct Bank, Deep Installation	75.7	53.8 / 53.8	19.6 / 19.6

Notes: 3W×4D = 3-Wide-By-4-Deep; ft = Foot; kV = Kilovolt; m = Meter; mG = Milligauss.

a. The two values presented correspond to the model-predicted fields at the given lateral distances to the left and right of the reference point, respectively, where the reference point for the duct bank, transition joint bay, and splice vault installation scenarios is the duct bank, transition joint bay, or splice vault centerline. For the Route 6 crossing microtunnel installation scenario, the values presented at lateral distances of 10 and 25 ft are for 10 and 25 ft from the outer microtunnel.

MF modeling performed for one additional installation case for the 275-kV onshore export cables, an underground 12-wide-by-1-deep (12W×1D) duct bank with copper plate shielding proposed for use for the Phinney's Bay culvert crossing on Dowses Beach Causeway in Barnstable, showed that the proposed use of copper plate shielding minimized aboveground MF levels from this shallow duct bank, with a maximum modeled MF level of 63.0 mG directly above the duct bank.

See Attachment 4 Section 4 for a detailed discussion of magnetic fields and the onshore export and grid interconnection cables.

Similar to the MF modeling for the offshore export cables, the MF modeling for both the underground onshore export and grid interconnection cable installation cases is expected to overpredict the magnitude of aboveground MF levels associated with the installed onshore export and grid interconnection cables. This is because minimum expected burial depths were assumed, and the currents used for the cables assume maximum wind farm output (100 percent capacity). In addition, the MF modeling analyses do not account for the phase conductors' main currents inducing currents on ground continuity conductors in the duct banks. Any induced currents on ground conductors would be expected to produce an MF that would tend to oppose (partially cancel) the MF arising from the phase conductor currents.

Section 4.0

Environmental Analysis of Potential Grid Interconnection Route Options

4.0 ENVIRONMENTAL ANALYSIS OF POTENTIAL GRID INTERCONNECTION ROUTE OPTIONS

4.1 Grid Interconnection Route Options

As described in Analysis Section 4.6, the Company identified three grid interconnection route options for the 345-kV portion of the onshore export cables that will connect the new onshore substation to the regional electric grid at the West Barnstable Substation (see Figure 4-1). The three grid interconnection route options are the same route options included in the Analysis, with some refinements based on further engineering, with the addition of a short variant (Variant 1) to Grid Interconnection Route G1. The following sections provide a basic description of the three grid interconnection route options and the variant. An environmental evaluation of the three grid interconnection route options including scoring and a comparison are provided in Sections 4.2 through 4.6. The costs of the three grid interconnection route options are considered similar, largely due to their similar route lengths and characteristics. Additionally, reliability was not a determining factor when comparing the three grid interconnection routes because all three route options would be equally reliable. As such, all route options were considered equal in terms of cost and reliability.

Figures 4-3A through D depict the limit of disturbance for each of the grid interconnection route options inclusive of the substation and access road development.

4.1.1 Grid Interconnection Route G1 – Fire Tower Access Road to Oak Street

Grid interconnection Route G1 is approximately 0.4 miles in length and includes installing the grid interconnection cables within the Fire Tower Access Road off Oak Street, then northeasterly along Oak Street, then into the northern portion of the West Barnstable Substation parcel. Grid Interconnection Route G1 would exit the substation site in the southeastern corner of Parcel 195-007 and cross the easternmost substation parcel (Parcel 195-008). The grid interconnection cables would then cross two additional parcels before reaching Oak Street. These two parcels are owned by the Town of Barnstable (Parcel 195-009, Kuhn Property) and the Barnstable Fire District (Parcel 195-010). The Kuhn property is Article 97 protected (see Figure 4-2). As proposed, the Fire Tower Access Road would be improved with gravel surfacing and widened to approximately 20 feet along its entire length (see Attachment 2). At Oak Street, Grid Interconnection Route G1 would follow Oak Street north for approximately 0.15 miles to the West Barnstable Substation parcel. Tree clearing associated with Grid Interconnection Route G1 alone would be approximately 0.2 acres, bringing the total tree clearing associated with the substation development plus development of this grid interconnection route to approximately 13.5 acres.

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Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

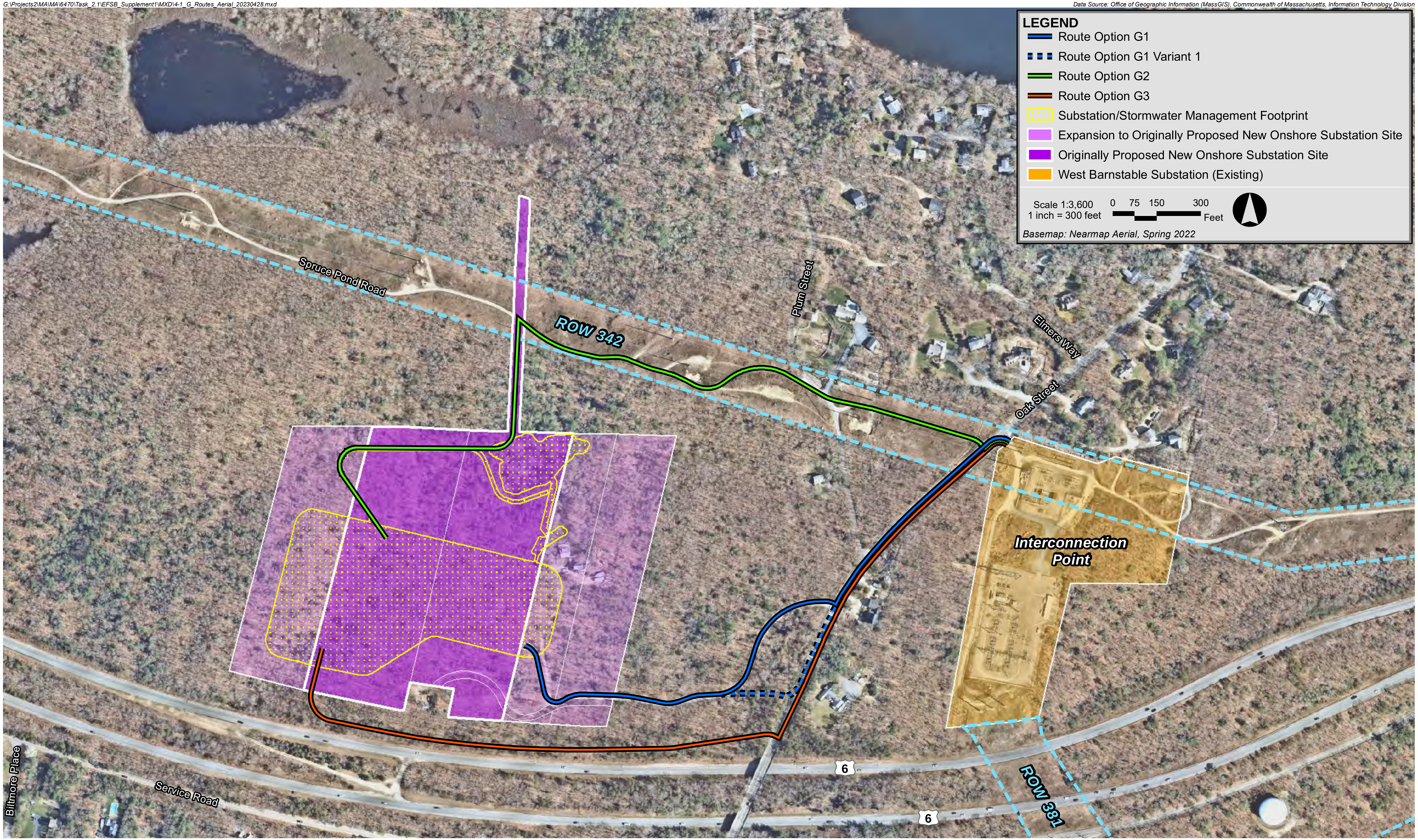

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Figure 4-1

Grid Interconnection Route Options – Aerial Locus

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Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

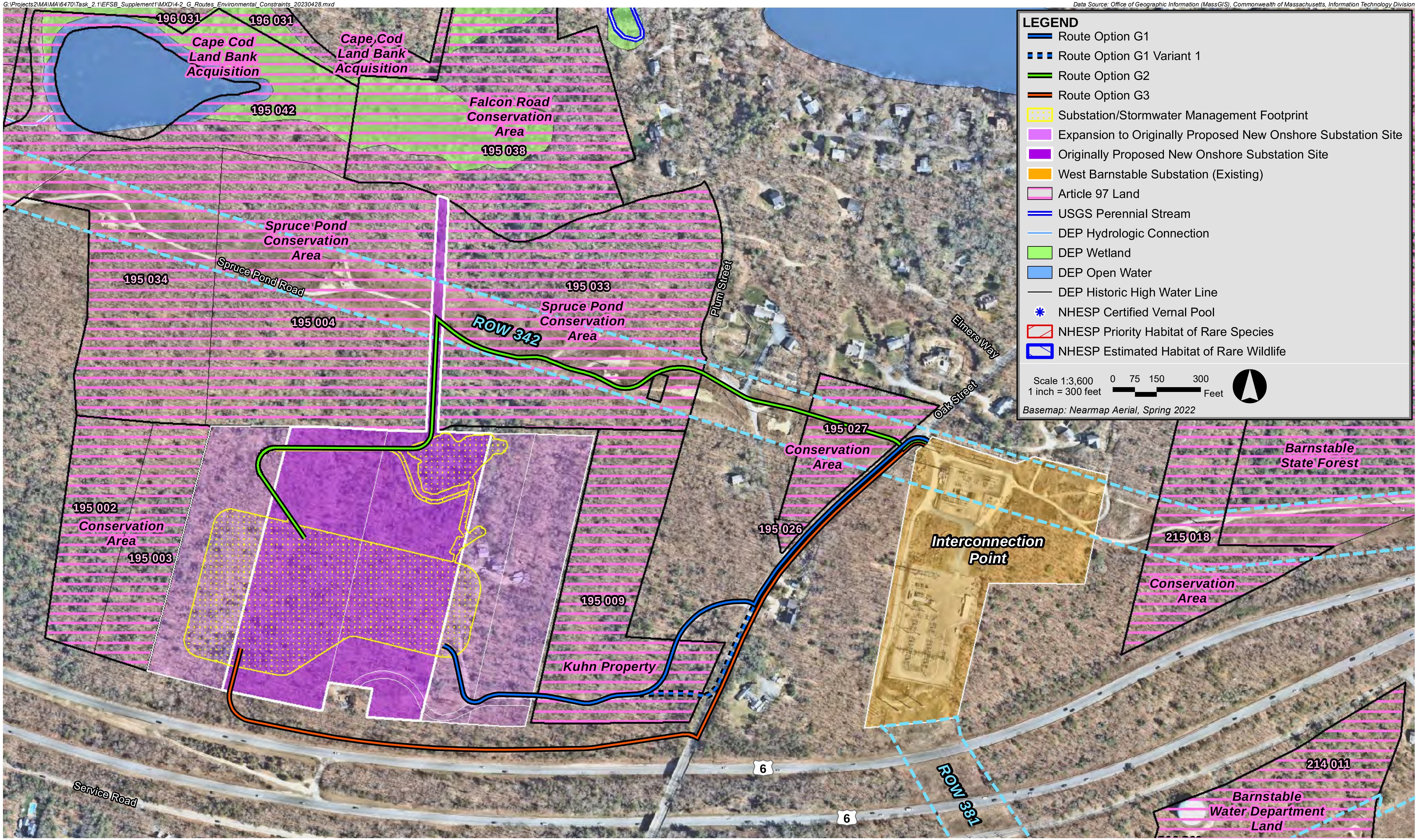

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Figure 4-2

Grid Interconnection Route Options – Environmental Constraints

As shown on Figure 2-3 and in the engineering plans provided as Attachment C7, a variant (i.e., Variant 1) to the Preferred grid interconnection route has also been identified. This variant would avoid the parcel owned by the Fire District by instead continuing east on what would be a new 20-foot-wide gravel access road cleared to Oak Street. This variant would only be utilized if it were infeasible to follow the route of the existing access road through the Fire District parcel, which requires obtaining an easement from the Barnstable Fire District. Where the new access road would intersect with Oak Street, Variant 1 would turn north on Oak Street and eventually rejoin Grid Interconnection Route G1 prior to arriving at the West Barnstable Substation. Variant 1 would have a total length of approximately 0.4 miles, the same length as Grid Interconnection Route G1. To reduce overall impacts while maintaining safe slopes for vehicular travel along the new access road, cut slopes have been designed at a 2:1 grade and fill slopes have been designed at a 3:1 grade. Some grading along the fire tower access road as it turns to the north would still be required to tie together grades from that existing road and the new access road. The intersection with Oak Street has been designed with a sufficient width to accommodate low-boy trailers that would be used to deliver heavy construction equipment and larger substation electrical equipment. Tree clearing associated with Variant 1 alone would be approximately 0.4 acres, bringing the total tree clearing associated with the substation development plus use of Variant 1 to approximately 13.7 acres, just 0.2 acres more than the total clearing for the substation and Grid Interconnection Route G1 without the Variant.

4.1.2 Grid Interconnection Route G2 – Eversource ROW #342

Grid Interconnection Route G2 is approximately 0.6 mile in length and includes installing the grid interconnection cables to the north within the approximately 40-foot-wide “panhandle” to the existing electric transmission corridor (Eversource ROW #342). The route would then turn to the east and be constructed within the existing Eversource ROW #342 corridor, crossing Plum and Oak Streets, and connecting into the northern portion of the West Barnstable Substation parcel. This grid interconnection route option would exit the substation to the north and follow the proposed approximately 20-foot-wide, gravel detention basin access road until it reached the approximately 40-foot-wide “panhandle” where it would then follow the panhandle north to existing Eversource ROW #342. The “panhandle” does not presently include an existing access road. A new approximately 20-foot-wide, gravel access road would be constructed within the “panhandle” and the 345-kV grid interconnection duct bank would be installed within the new gravel access road. Construction of this route would require tree clearing and grading on topographically challenging terrain along the narrow “panhandle.” Based on the terrain along the narrow “panhandle,” the current engineering design also requires limited grading and tree and vegetation removal on adjacent parcels to the east and west subject to Article 97 jurisdiction. To the extent practicable, the approximately 20-foot-wide grid interconnection route will be designed to be consistent with the limits of the existing access road within the existing Eversource ROW #342. However, clearing and grading on certain undeveloped portions of the existing Eversource ROW would be required. The existing intersection / crossing with Plum Street may also be redesigned to provide access to Oak Street. Additional rights would need to be obtained from Eversource to locate the grid interconnection cables within their ROW.

Tree clearing associated with Grid Interconnection Route G2 alone would be approximately 0.5 acres, bringing the total tree clearing associated with the substation development plus development of the Grid Interconnection Route G2 route to approximately 13.8 acres.

4.1.3 Grid Interconnection Route G3 – Route 6 State Highway Layout to Oak Street

Grid Interconnection Route G3 is approximately 0.6 mile in length and includes installing the grid interconnection cables within the northern portion of the existing Route 6 State Highway Layout from the proposed onshore substation site to Oak Street. This route would be located within a new proposed 20-foot-wide gravel access road within the Route 6 State Highway Layout up to the intersection with Oak Street, then would turn north along Oak Street for approximately 0.25 mile, and then into the northern portion of the West Barnstable Substation parcel. Grid Interconnection Route G3 would exit the substation site along its southern boundary, west of the existing DCR Fire Tower parcel. This grid interconnection route option would require additional access permits and coordination with MassDOT. Clearing vegetation within the state highway layout would be required and could reduce the vegetative visual buffer between Route 6 and the new onshore substation.

Tree clearing associated with Grid Interconnection Route G3 alone would be approximately 1.9 acres, bringing the total tree clearing associated with the substation development plus development of the Grid Interconnection Route G3 to approximately 15.2 acres.

Table 4-1 provides a summary of the parcels crossed for each of the substation/access road/grid interconnection route options and total area of each parcel to be disturbed including grading and tree and vegetation removal based on current engineering design. Figures 4-3 A through D depict the limit of disturbance for each of the substation/access road/grid interconnection route options.

Table 4-1 Summary of Parcels Crossed and Impacts by Parcel for the Substation/Access Road/ Grid Interconnection Routes

Substation/Access Road/Grid Interconnection Route Option [a]	***# of Parcels***	***Parcel ID*** [b]	***Area of Disturbance (acres)***
Grid Interconnection Route Option G1 (Fire Tower Access Road to Oak Street) [c]	Oak Street ROW and 9 parcels	195-037 (Onshore Substation Parcel 5)	3.3
		195-005 (Onshore Substation Parcel 4)	5.1
		195-006 (Onshore Substation Parcel 3)	4.0
		195-007 (Onshore Substation Parcel 2)	1.7
		194-015 (Onshore Substation Parcel 7)	0.02
		195-008 (Onshore Substation Parcel 1)	0.10
		194-014 (Onshore Substation Parcel 8)	0.01
		195-009 (Kuhn Property)	0.4
		195-010 (Fire District)	0..1
		Oak Street Public Right-of-Way [d]	0.3
		G1 Total Area Disturbed	***14.9*** [e]

Table 4-1 Summary of Parcels Crossed and Impacts by Parcel for the Substation/Access Road/ Grid Interconnection Routes (Continued)

Substation/Access Road/Grid Interconnection Route Option [a]	*# of Parcels*	*Parcel ID* [b]	*Area of Disturbance (acres)*
Grid Interconnection Route Option G1-Variant 1 (Fire Tower Access Road to Oak Street) [c]	Oak Street ROW and 8 parcels	195-037 (Onshore Substation Parcel 5)	3.3
		195-005 (Onshore Substation Parcel 4)	5.1
		195-006 (Onshore Substation Parcel 3)	4.0
		195-007 (Onshore Substation Parcel 2)	1.7
		194-015 (Onshore Substation Parcel 7)	0.02
		195-008 (Onshore Substation Parcel 1)	0.10
		194-014 (Onshore Substation Parcel 8)	0.01
		195-009 (Kuhn Property)	0.4
		Oak Street Public Right-of-Way [d]	0.4
		G1 Total Area Disturbed	***15.0*** [e]
Grid Interconnection Route Option G2 (Eversource ROW #342)	Oak Street ROW and 11 parcels	195-037 (Onshore Substation Parcel 5)	3.30
		195-005 (Onshore Substation Parcel 4)	5.1
		195-006 (Onshore Substation Parcel 3)	4.5
		195-007 (Onshore Substation Parcel 2)	1.3
		195-004 (Spruce Pond Conservation Area)	0.1
		195-033 (Spruce Pond Conservation Area)	0.7
		195-032 (Eversource Energy – Commonwealth Electric c/o NSTAR Electric Company)	0.01
		ROW #342: Private property (195-011 [residential])	0.06
		ROW #342: Private property (195-025 [residential])	0.01
		ROW #342: Private property (195-025-001 [residential])	0.1
		ROW #342: Private property (195-027 [conservation area])	0.2
		Plum Street Right-of-Way [d]	0.05
		Oak Street Public Right-of-Way [d]	0.04
		G2 Total Area Disturbed	***15.4*** [e]
Grid Interconnection Route Option G3 (Route 6 State Highway Layout to Oak Street)	Oak Street ROW, SHLO, and 4 parcels	195-037 (Onshore Substation Parcel 5)	3.4
		195-005 (Onshore Substation Parcel 4)	5.2
		195-006 (Onshore Substation Parcel 3)	4.0
		195-007 (Onshore Substation Parcel 2)	1.3
		Route 6 State Highway Layout	1.7
		Oak Street Public Right-of-Way [d]	0.4
		G3 Total Area Disturbed	***16.00*** [e]

a. Area of disturbance calculation includes the areas required for the development of the new onshore substation and access road. The grid interconnection cables contained within an underground concrete duct bank will be installed within the access road to the new onshore substation.

b. Parcels highlighted in BLUE denote Article 97 jurisdictional lands.

c. Total area of disturbance for each parcel was calculated based on the assumption that each parcel extends to the centerline of the existing Fire Tower Access Road.

d. Assumes disturbance for an approximate 13-foot-wide duct bank trench within Oak Street public roadway right-of-way. Assumes all grid interconnection routes enter the existing West Barnstable Substation parcel in the same location.

e. The total area of disturbance does not include the approximately 1.5 acres of disturbance within the existing Eversource 345-kV West Barnstable Substation parcel for modifications and upgrades.

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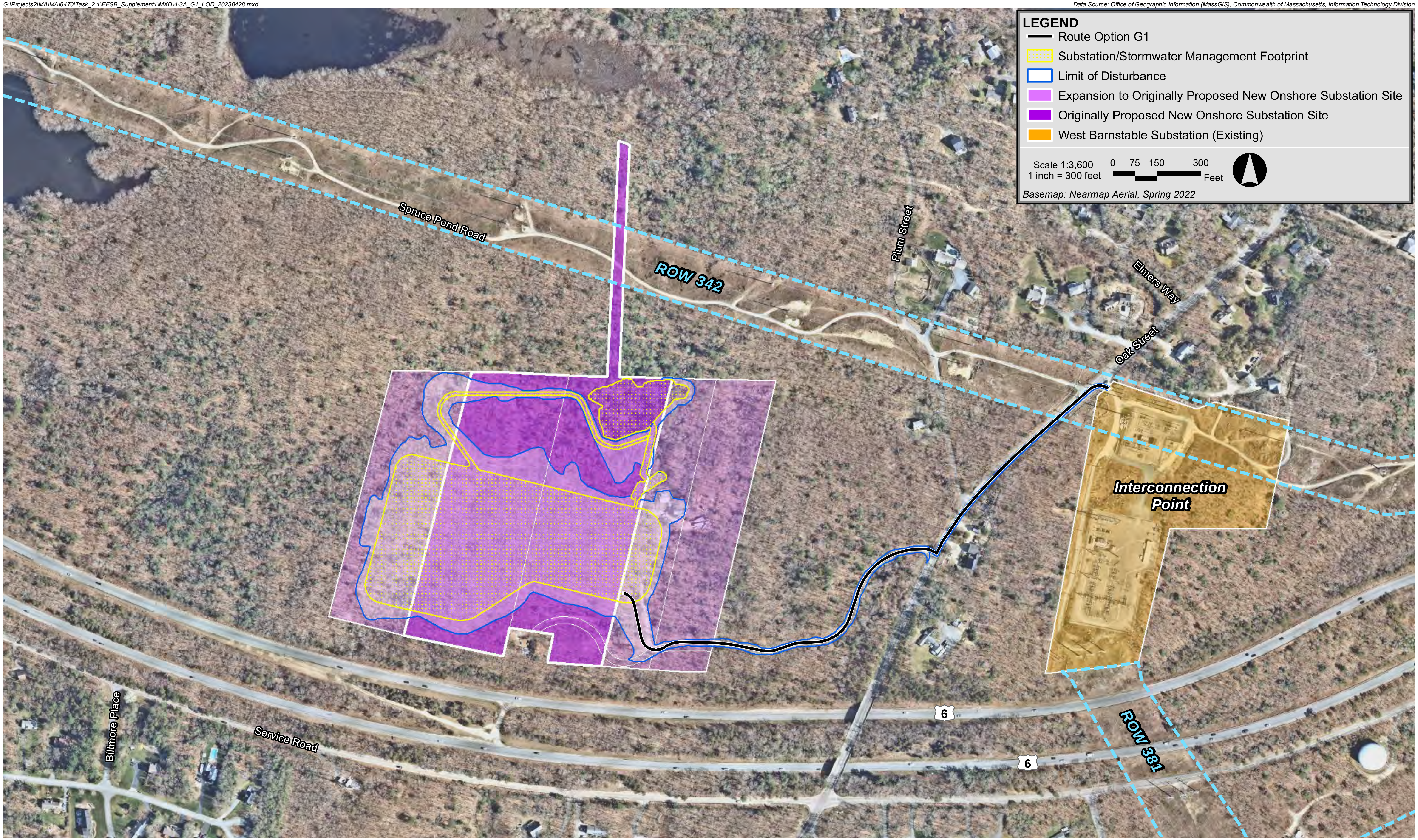

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Figure 4-3A

Substation/Access Road/Grid Interconnection Route Option G1 (Fire Tower Access Road to Oak Street) – Limit of Disturbance

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Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

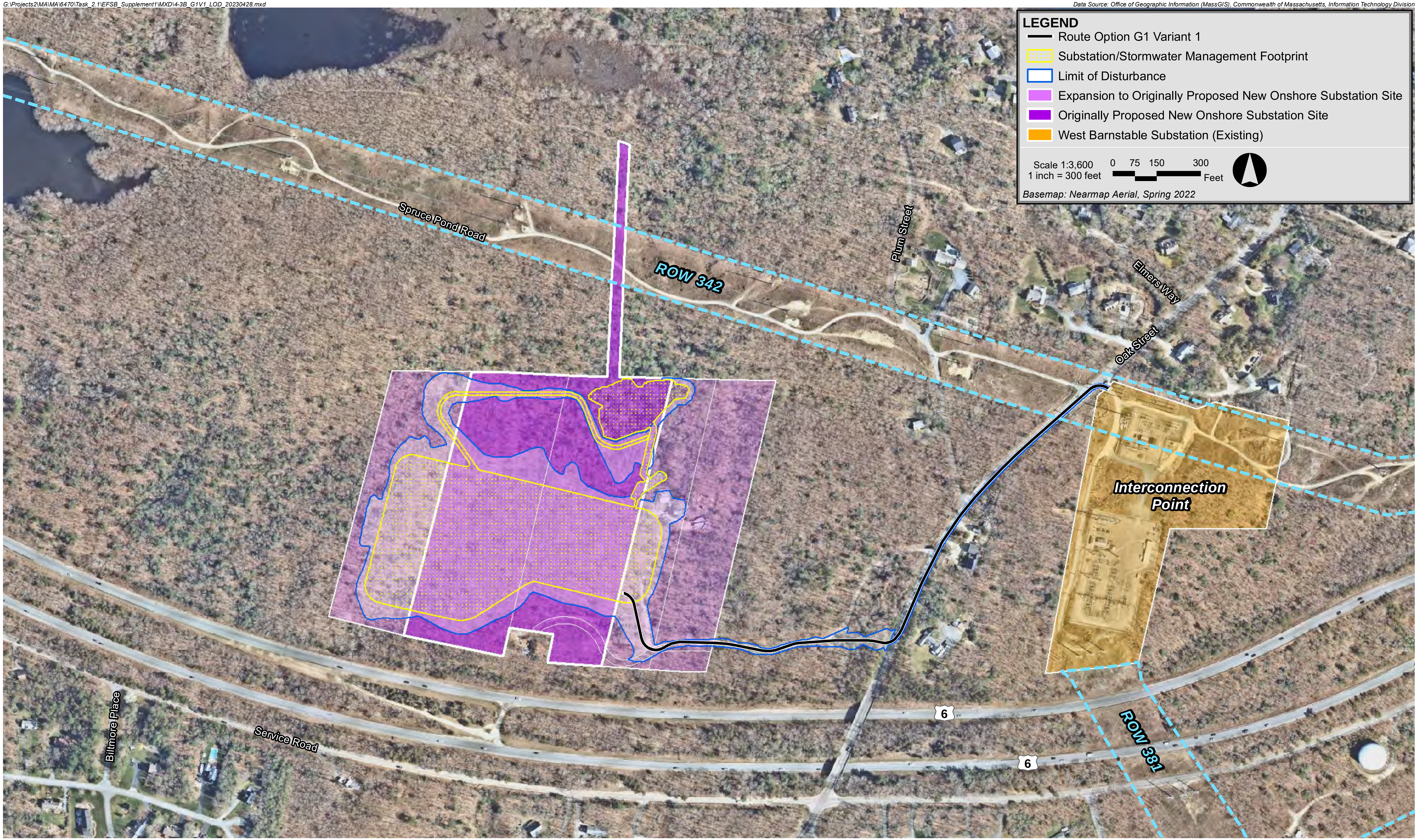

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Figure 4-3B

Substation/Access Road/Grid Interconnection Route Option G1 Variant 1 (Fire Tower Access Road/Kuhn Property to Oak Street) – Limit of Disturbance

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

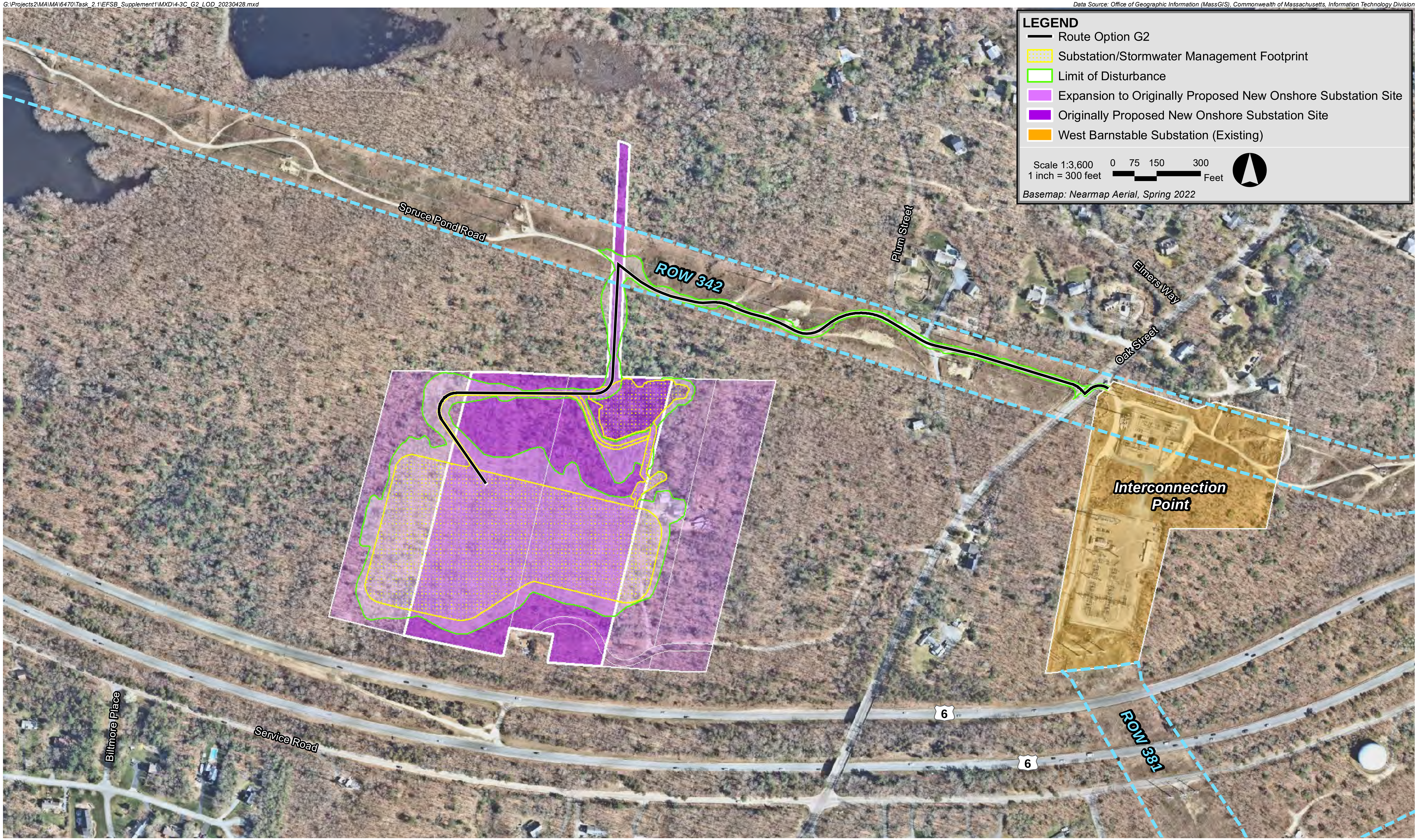

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Figure 4-3C

Substation/Access Road/Grid Interconnection Route Option G2 (Eversource ROW #342) – Limit of Disturbance

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Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

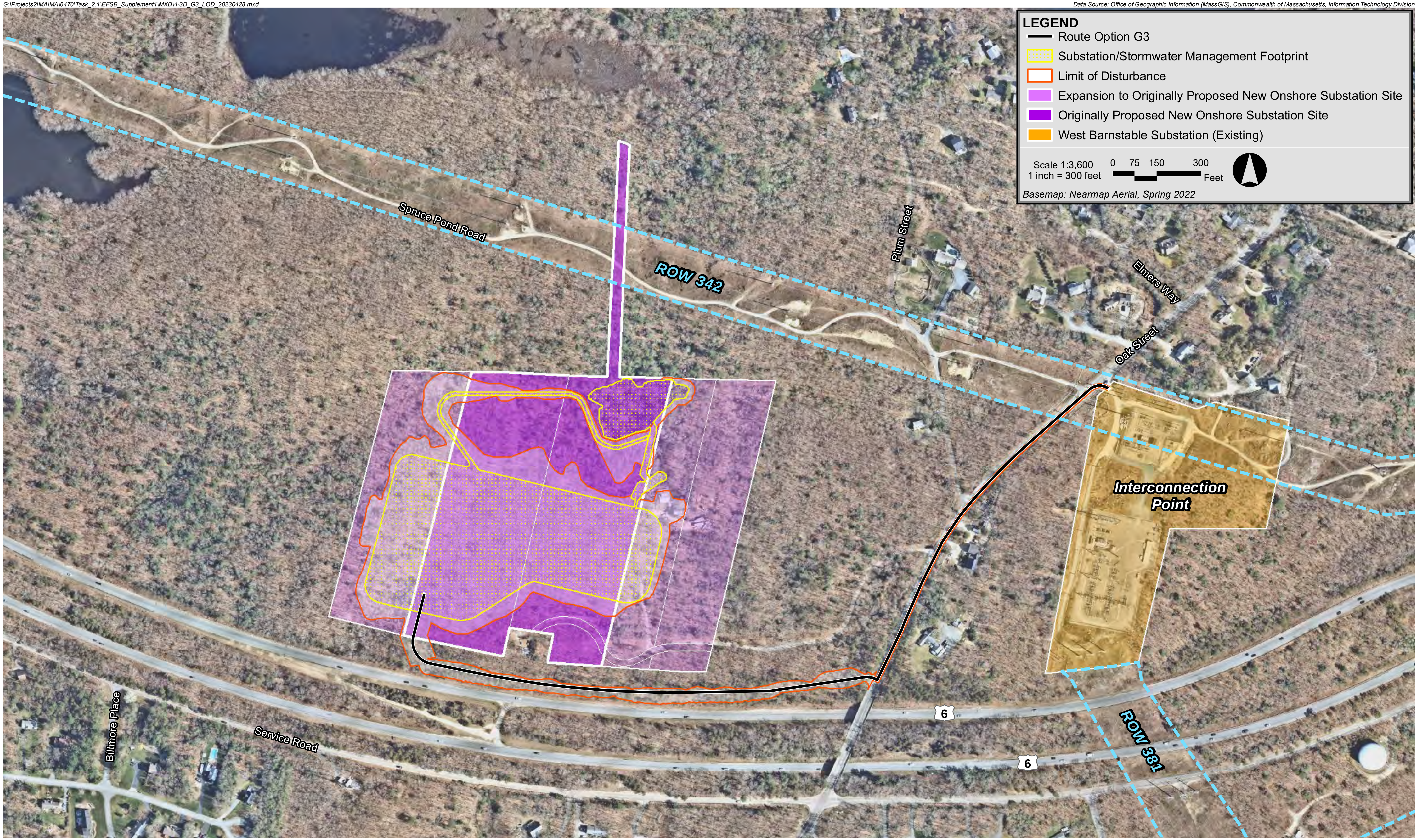

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Figure 4-3D

Substation/Access Road/Grid Interconnection Route Option G3 (Route 6 State Highway Layout to Oak Street) – Limit of Disturbance

4.2 Environmental Analysis of Grid Interconnection Route Options

Following further engineering review and analysis, the Company conducted an environmental scoring analysis for the three grid interconnection route options, including the Variant 1 associated with Grid Interconnection Route G1. Similar to the onshore export cable Candidate Routes (from the Parking Lot Landfall site to the new onshore substation), the environmental scoring analysis for the grid interconnection route options included individual criteria that compare the relative levels of potential impacts to the developed and natural environments along the grid interconnection route options. The individual criteria used to evaluate the grid interconnection route options are consistent with the criteria used to evaluate the seven onshore export cable Candidate Routes except for potential for traffic congestion. Potential for traffic congestion was not included as an individual scoring criterion for the grid interconnection routes as the maximum length that any of the grid interconnection route options would be located within existing public roadway layout (Oak Street) is approximately 0.25 mile and traffic management measures will be implemented as necessary to help manage and mitigate any unavoidable temporary impacts to traffic where the grid interconnection route options are proposed within existing roadway layouts. The scoring criteria for the grid interconnection route options are defined in Table 4-2 and are described in greater detail in Section 4.4.

The six developed environment criteria, defined in Section 4.4.1, compare existing conditions of, and potential impacts to, the developed environment along each grid interconnection route option. The five natural environment criteria, defined in Section 4.4.2, compare existing conditions of, and potential impacts to, the natural environment along each grid interconnection route option.

As described in Analysis Section 4.5.6.1, the Company assigned weights to all criteria based on an assessment of the potential for temporary and permanent impacts, as well as the magnitude of disruption from those impacts and regulatory importance for permitting. The weighting scale ranges from 1 to 3, with 1 being the lowest weight and 3 being the highest weight that could be applied to a particular criterion. The assignment of weights to individual scoring criteria during the scoring and evaluation of the Candidate Routes was retained for the grid interconnection route options. The assignment of weights to individual scoring criteria allows route scoring results to reflect the relative importance of individual evaluation criteria. The Company assigned the individual criteria weights based upon an assessment of the potential for temporary and permanent impacts and to reflect public feedback. Using this approach, the highest weightings were given for criteria pertaining to the greatest risk for significant impacts, public benefits, Project cost, and schedule. Those criteria that are least likely to affect these considerations are given the lowest weighting. Table 4-3 describes the weights applied to each evaluation criterion.

Table 4-2 Scoring Criteria for the New England Wind 2 Connector Grid Interconnection Route Options Analysis

Criteria	*Purpose*	*Data Source*	*Scoring*	*Ratio Score*
Developed Environment Criteria				
Residential Units	Residents along a grid interconnection route option could be subject to temporary impacts from construction, such as traffic disruption, noise, dust, and/or other short-term construction-related impacts.	MassGIS, aerial photography, municipal records (including large multi-unit complexes where possible)	# of residential units with parcels directly abutting the grid interconnection route options.	Calculated for each grid interconnection route option based on the total # of individual residential units determined for each grid interconnection route option divided by the highest # of residential units found along all the grid interconnection route options.
Commercial / Industrial Units	Commercial and Industrial businesses along a grid interconnection route option could be subject to temporary impacts from construction, such as traffic disruption, noise, dust, and/or other short-term construction-related impacts.	MassGIS, aerial photography, municipal records (including large multi-unit complexes where possible)	# of commercial and industrial units with parcels directly abutting the grid interconnection route options.	Calculated for each grid interconnection route option based on total # of individual commercial and industrial units determined for each grid interconnection route option divided by the highest # of units found along all the grid interconnection route options.
Sensitive Receptors (hospitals, schools, police stations, fire stations, elder care facilities, daycares, district courts, and religious facilities)	Sensitive receptors could be subject to temporary construction impacts such as traffic disruption, street closures, noise, dust, and/or other short-term construction-related impacts. If a receptor has multiple entrances, the impact can be less pronounced than under single-entrance scenarios.	Property assessment data from MassGIS and local online databases, Google, and Bing 2015-2016 aerial imagery as well as Google Earth/Google Maps data and imagery	# of sensitive receptors with parcels directly abutting each grid interconnection route option.	Calculated by dividing the total # of sensitive receptor parcels for each grid interconnection route option by the highest # of sensitive receptor parcels found among all the grid interconnection route options.
Historic Resources (*Archaeology evaluated separately, below, given the relative regional importance of these resources to undeveloped areas of Cape Cod)*	Could potentially be affected by temporary construction impacts.	MassGIS data from MHC's Massachusetts Cultural Resource Information System (July 2022)	# of historic resources derived from the total number of historic sites directly abutting each grid interconnection route option. If the abutting historic resource is an area or district with multiple parcels, then the area/district was counted and then the parcels within the area/district directly abutting the route were counted as well (but non-abutting parcels were not counted). If identified archaeological sites abut a route, they were also included in the count.	Calculated for each grid interconnection route option based on the total # of historic resources determined for each grid interconnection route option divided by the highest # of historic resources found among all of the grid interconnection route options.
Archaeological Resources	Areas of moderate to high archaeological sensitivity were identified based on environmental attributes, such as well drained soils on level to slightly sloping terrain in proximity to settings with high natural resource potential such as tidal flats, salt marsh and creek systems, freshwater rivers, wetlands and ponds, and proximity to recorded archaeological sites. Areas observed as having obvious disturbance were ranked as low sensitivity zones. Areas of greater than 15% slope, or bodies of standing water had no archaeological sensitivity.	Archaeological Sensitivity Assessment by archaeology consultant	Derived from the total length (miles) of each grid interconnection route option passing through areas of "moderate" and "high" archaeological sensitivity.	Calculated for each grid interconnection route option based on the total # of miles of archaeologically sensitive areas determined for each grid interconnection route option divided by the highest # of miles found among all of the grid interconnection route options.

Table 4-2 Scoring Criteria for the New England Wind 2 Connector Grid Interconnection Route Options Analysis (Continued)

Criteria	*Purpose*	*Data Source*	*Scoring*	*Ratio Score*
Developed Environment Criteria				
Potential to Encounter Subsurface Contamination	Subsurface contamination could add complexities to construction.	MassGIS Activity and Use Limitation (AUL) and Chapter 21E Tier Classified Sites data layers MassDEP Bureau of Waste Site Cleanup (BWSC) online database	Derived from the number of sites on or within 300 feet of each grid interconnection route option where a documented release of oil and/or hazardous materials occurred, or where past land uses potentially resulting in contamination have been documented in the BWSC database, pursuant to the Massachusetts Contingency Plan (MCP) (310 CMR 40.0000).	Calculated by dividing the total # of documented sites determined for each grid interconnection route option by the highest # of documented sites found among all the grid interconnection route options.
Natural Environment Criteria				
Wetland Resource Areas	Wetland resource areas could potentially be affected by construction impacts.	MassGIS	Derived from the total length that each grid interconnection route option passes through mapped jurisdictional wetland resource areas, including 200-foot riverfront area, and 100-year floodplain (but excluding buffer zones).	Calculated by dividing the total combined length of jurisdictional areas crossed by each grid interconnection route option by the longest total combined length among all the grid interconnection route options.
State-Listed Rare Species Habitat	Construction could potentially impact protected habitats for state-listed rare species.	ArcGIS and applying MassGIS mapping of NHESP Priority and Estimated Habitat areas	Derived from the total length that each grid interconnection route option passes through mapped protected habitat (Priority or Estimated habitats) for state-listed species.	Calculated by dividing the total combined length of mapped NHESP Priority and Estimated Habitat areas crossed by each grid interconnection route option by the longest total combined length among all the grid interconnection route options.
Public Water Supplies	Public water supply areas considered in this routing analysis include Zone I and Zone II Water Supply Protection Areas and Interim Wellhead Protection Area (IWPA).	MassGIS	Derived from the total length that each grid interconnection route option passes through a mapped public water supply area identified through MassGIS.	Calculated by dividing the total combined length of mapped public water supply areas crossed by each grid interconnection route option by the longest total combined length among all the grid interconnection route options.
Article 97-Jurisdictional Land	Conservation lands defined as those properties that were primarily protected for conservation purposes (subject to Article 97 jurisdiction) as identified through MassGIS and property records, as deemed necessary.	MassGIS and property records, as deemed necessary.	Number of distinct areas subject to Article 97 jurisdiction as identified through MassGIS (or property records) that are crossed by each grid interconnection route option. Public roadway layouts are excluded from the count.	Calculated by dividing the total number of areas identified as subject to Article 97 jurisdiction crossed by each grid interconnection route option by the highest number of areas subject to Article 97 jurisdiction among all the grid interconnection route options.
Tree Clearing	Naturally vegetated areas containing a mature forest canopy provide habitat for various wildlife species and can provide visual screening.	MassGIS and current aerial photography	Derived from the total area that each grid interconnection route option requires clearing of forested habitat calculated based on the preliminary engineering limits of work for each grid interconnection route option but excluding non-forested areas such as at road crossings, cleared areas, and ROW access roads.	Calculated by dividing the total combined area of tree clearing required for each grid interconnection route option by the largest total combined area of tree clearing required among all the grid interconnection route options.

Table 4-3 Weighting assigned to scoring criteria for Grid Interconnection Route Options

Scoring Criteria	*Weight*	*Rationale Behind Assigned Weight*
Developed Environment		
Residential Units	3	The highest weighting was applied to residential units due to the potential for temporary disruption during construction.
Commercial/Industrial Units	3	The highest weighting was applied to commercial/industrial units due to the potential for temporary disruption during construction. However, no commercial or industrial units with parcels directly abutting any of the grid interconnection route options were identified.
Sensitive Receptors	2	A middle weighting was applied to sensitive receptors in acknowledgement of their susceptibility to temporary disruption from construction activities, and the need to maintain access to these facilities throughout construction. No sensitive receptors with parcels directly abutting any of the grid interconnection route options were identified.
Historic Resources	1	The lowest weighting was applied to historic resources since the Project-related impacts to historic resources will be limited to temporary construction-related activities.
Archaeological Resources	1	The lowest weighting was applied to archaeological resources. It should be noted that if archaeological sites abutting the routes were included in the Inventory of Historic and Archaeological Assets of the Commonwealth (Inventory) or listed on the National Register of Historic Places or State Register of Historic Places, they were also included in the historic resources count.
Potential to Encounter Subsurface Contamination	1	No sites on or within 300 feet of a grid interconnection route option where a documented release of oil and/or hazardous materials occurred or where past land uses potentially resulting in contamination have been documented in the BWSC database, pursuant to the MCP (310 CMR 40.0000), were identified for any grid interconnection route option.
Natural Environment		
Wetland Resource Areas	2	A middle weighting was applied to wetland resource areas due to the sensitivity of these environmental resources as well as the permitting challenges associated with related impacts.
Rare Species Habitat	2	A middle weighting was applied to rare species habitat due to the sensitivity of these environmental resources as well as the permitting challenges associated with related impacts.
Public Water Supplies	1	The lowest weighting was applied to public water supplies since the Project's construction-related activities will be performed in a manner that will avoid impacts to water supply resources, and because the Project is not of a type that would pose a significant threat to these resources.
Article 97-Jurisdictional Land	2	A middle weighting was applied to this criterion due to the Project crossing land identified as land subject to Article 97 jurisdiction, which is land held for natural resource purposes.
Tree Clearing	3	The highest weighting was applied to tree clearing as tree clearing would be a permanent impact within the designated corridor.

4.3 Grid Interconnection Route Options Scoring Evaluation Methods

After identifying the environmental scoring criteria, the Company completed a scoring evaluation for each grid interconnection route option. The Company scored, weighted, and ranked each grid interconnection route option to reflect its potential for impacts to the developed and natural environments and its relative ease of constructability. For a project of this type, the relative ease of constructability is directly related to several factors including the amount of available workspace, extent of densely developed residential and commercial areas, traffic, and potential conflicts with other buried infrastructure. These parameters were considered in developing some of the human environment criteria and are therefore represented in the Company's scoring process. Therefore, constructability criteria were not included in the scoring process for grid interconnection route options in the same way that developed and natural environment criteria were reflected in the analysis.

After gathering mapping and data for each grid interconnection route option, the Company identified the grid interconnection route option that had the highest number for each criterion. All other route options were then compared against this number to arrive at a "ratio score" for each grid interconnection route option on a scale of 0 to 1. For example, if grid interconnection route option X had 5 sensitive receptors, grid interconnection route option Y had 10 sensitive receptors, and grid interconnection route option Z had 15 sensitive receptors, the ratio scores would be calculated as shown:

Candidate Route	Number of Sensitive Receptors	Unweighted Raw Ratio Score
Route Option X	5	5 ÷ 15 = **0.33**
Route Option Y	10	10 ÷ 15 = **0.66**
Route Option Z	15	15 ÷ 15 = **1.00**

The lowest ratio score therefore equates to the lowest potential for impact.

For each criterion, the ratio score was then multiplied by its assigned weight to produce a weighted score that reflected the relative importance of the individual criteria. As described above, a 1-to-3 scale for weighting was used to reflect the degree of importance of each criterion, with 1 being the lowest weight and lesser importance and 3 being the highest weight and greater importance.

For each grid interconnection route option, the analysis generated a "total ratio score" by summing all of the individual ratio scores from the scoring criteria as well as a "total weighted score" by summing all of the individual weighted scores from the scoring criteria. The total weighted scores were then sorted in order, from low to high, to identify a given grid interconnection route option's "rank." The lowest weighted score equates to the lowest potential for impact with emphasis on certain criterion as previously described in this section. The ranks developed in this routing analysis are based on the total weighted scores.

4.4 Description of Grid Interconnection Route Options Scoring Criteria

The scoring criteria for the developed environment and natural environment used to evaluate the grid interconnection route options, as defined in Table 4-2 above, are described in greater detail below.

4.4.1 Developed Environment Criteria

Developed environment criteria compare existing conditions of, and potential impacts to, the developed environment and surrounding population along the grid interconnection route options. The six developed environment criteria are described below.

Residential Units

Residents along a route could be subject to temporary impacts from construction, such as traffic disruption, noise, dust, or other short-term construction-related impacts. The number of residential units with parcels directly abutting the routes were counted using MassGIS data, aerial photography, and municipal records to determine the number of units along each grid interconnection route option. Note, no large multi-unit apartment or condominium complexes were identified along any of the grid interconnection route options.

The ratio score was calculated for each Candidate Route based on the total number of individual residential units determined for each grid interconnection route divided by the highest number of units found among all the grid interconnection route options.

Commercial/Industrial Units

Commercial and Industrial businesses along a grid interconnection route could be subject to the same types of temporary impacts as residential units due to construction. No commercial or industrial units were identified on any parcels of land directly abutting any of the grid interconnection route options. Commercial/industrial land uses were identified using MassGIS data, aerial photography, and municipal records.

Sensitive Receptors

Sensitive receptor land uses include hospitals, schools, police stations, fire stations, elder care facilities, daycare facilities, district courts, and religious facilities. Sensitive receptors along each grid interconnection route could be subject to temporary traffic disruption, street closures, construction noise, or other temporary impacts due to Project construction.

The number of sensitive receptors includes the number of parcels directly abutting each grid interconnection route with a land use type identified as sensitive to the above temporary impacts. The number of sensitive receptors was evaluated using available property assessment data from MassGIS and local online databases, Google and Bing 2015-2016 aerial and street imagery, and Google Earth/Google Maps data and imagery. No sensitive receptors with parcels directly abutting any of the grid interconnection route options were identified.

Historic Resources

Historic resources could potentially be affected by construction impacts such as earth movement, traffic disruption, street closings, and noise, as well as by the permanent placement of transmission facilities in or near cultural resources. Historic resources were evaluated using MassGIS data from the Massachusetts Historical Commission's (MHC) Massachusetts Cultural Resource Information System (MACRIS) to locate resources including buildings, local historic districts, and National Register-listed individual buildings and districts. Historic Resources located along the grid interconnection route options are either included in the Inventory of Historic and Archaeological Assets of the Commonwealth (Inventory) or listed on the National Register of Historic Places (NR) or State Register of Historic Places (SR). Resources are either singular historic properties or listed in the NR or SR as a district or included in the Inventory as a single property or as an Area containing multiple properties.

For the purposes of scoring, single historic properties, Areas, and Districts immediately adjacent to the grid interconnection route options were each counted once. If the grid interconnection route option passes through an Area or District with multiple parcels, then the Area or District is counted once and the parcels within the Area or District directly abutting the grid interconnection route option are counted as well (but non-abutting parcels are not counted).

If identified archaeological sites abut the routes, they are also included in the count; however, archaeological resources were also evaluated separately, as noted below.

The number of historic resources was derived from the total number of historic and archaeological sites and the number of parcels within historic districts or areas abutting each grid interconnection route option.

The ratio score was calculated for each grid interconnection route option based on the total number of historic resources determined for each grid interconnection route option divided by the highest number of historic resources found along all of the grid interconnection route options.

Archaeological Resources

Archaeological resources can be impacted by the disturbance of subsurface artifacts through earth movement and excavation.

Areas of moderate to high archaeological sensitivity were identified based on environmental attributes, such as well drained soils on level to slightly sloping terrain in proximity to settings with high natural resource potential such as tidal flats, salt marsh and creek systems, freshwater rivers, wetlands and ponds, and proximity to recorded archaeological sites. Areas observed as having obvious disturbance were ranked as low sensitivity zones. Areas of greater than 15% slope, or bodies of standing water had no archaeological sensitivity.

The ratio score was calculated for each grid interconnection route option based on the total number of miles of archaeologically sensitive areas determined for each grid interconnection route option divided by the highest number of miles found along all of the routes.

Potential to Encounter Subsurface Contamination

Subsurface contamination could add complexities to construction. The potential to encounter subsurface contamination was derived from the number of sites on or within 300 feet of each grid interconnection route option where a documented release of oil and/or hazardous materials occurred, or where past land uses potentially resulting in contamination have been documented in the MassDEP Bureau of Waste Site Cleanup (BWSC) online database, pursuant to the Massachusetts Contingency Plan (MCP) (310 CMR 40.0000). This criterion was evaluated using the MassDEP BWSC online database. No documented BWSC sites were identified on or within 300 feet of any of the grid interconnection route options.

4.4.2 Natural Environment Criteria

Natural environment criteria compare existing conditions of, and potential impacts to, the natural environment among the grid interconnection route options. The five natural environment criteria included in the scoring analysis are described in detail below.

Wetland Resource Areas

Onshore underground duct bank construction could affect wetland resource areas. This criterion score was derived from the total linear footage of each grid interconnection route option passing through mapped wetland resources, including 200-foot riverfront area and the 100-year floodplain (but excluding buffer zones). Wetland resource areas applicable to the routing analysis, as defined in the Massachusetts Wetland Protection Act (WPA) regulations (310 CMR 10.00) and/or local wetlands regulations, include the following:

- Bordering Vegetated Wetland (BVW);
- Isolated Vegetated Wetlands or Lands Subject to Flooding (IVW or LSF); and
- 200-foot Riverfront Area (RFA).

Wetland resource areas were reviewed utilizing ArcGIS with the most current data available. No mapped wetland resource areas were identified along any of the grid interconnection route options. There were no Areas of Critical Environmental Concern (ACECs) or Outstanding Resource Waters (ORWs) present along any of the grid interconnection route options.

State-listed Rare Species Habitat

Onshore underground duct bank construction could potentially impact protected habitats for state-listed rare species. Scoring of protected habitats for state-listed species from the areas of Priority or Estimated Habitat, as defined by Natural Heritage & Endangered Species Program (NHESP), was derived from the total linear footage of each grid interconnection route passing through mapped Priority or Estimated Habitat.

Areas of rare species habitat were reviewed utilizing ArcGIS and applying MassGIS mapping of NHESP Priority and Estimated Habitat areas. No areas of mapped rare species habitat were identified along any of the grid interconnection route options.

Public Water Supplies

Public water supply areas considered in this aspect of the routing analysis included the boundaries of Zone I and Zone II Water Supply Protection Areas and Interim Wellhead Protection Areas (IWPA). These resources were identified using available data layers from MassGIS along the grid interconnection route options. The length of each route that passed through a public water supply resource area was calculated using ArcGIS.

The ratio score was calculated for each grid interconnection route by dividing the total combined length of public water supply resources along each route by the longest total combined length among all the grid interconnection route options.

Article 97-Jurisdictional Land

Onshore underground cable construction could potentially result in impacts to Article 97 land, as identified in available MassGIS data. Underground installation within public roadway layouts was assumed to have no impact on adjacent Article 97 lands. The score for this criterion was derived from the total number of distinct areas shown as protected under Article 97 by MassGIS that are crossed by each grid interconnection route option.

A ratio score was calculated for each grid interconnection route option by dividing the total number of protected areas crossed by each grid interconnection route option by the highest number of protected areas among all the grid interconnection route options.

Tree Clearing

Based on further engineering review and analysis, portions of each of the grid interconnection route options may require tree clearing of forested habitat. Underground installation within public roadway layouts was assumed to require no tree clearing for scoring purposes; however, depending on final duct bank design, selective tree removal and/or trimming may be required. Any vegetation removal would be completed in accordance with all applicable state and local laws and regulations.

The ratio score for each grid interconnection route option was calculated by dividing the total combined area of tree clearing required for each substation/access road/grid interconnection route option by the largest total combined area of tree clearing required among all the substation/access road/grid interconnection route options. This estimated area was calculated based on the preliminary engineering limits of work for each substation/access road/grid interconnection route option but excluding non-forested areas such as at road crossings, cleared areas, and ROW access roads.

4.5 Grid Interconnection Routing Environmental Analysis Results

The Company applied the scoring and weighting methodology described above to each of the grid interconnection route options. Table 4-4 presents the weighted scores for each criterion for each grid interconnection route option. Detailed scoring spreadsheets are provided in Attachment 5.

Table 4-4 Comparison of Environmental Weighted Ratio Scores – Grid Interconnection Route Options

Scoring Criteria	*Grid Interconnection Route Option G1 (Fire Tower Access Road)*	*Grid Interconnection Route Option G1 – Variant 1 (Fire Tower Access Road)*	*Grid Interconnection Route Option G2 (Eversource ROW #342)*	*Grid Interconnection Route Option G3 (Route 6 SHLO)*
	Developed Environment			
Residential Units	1.50	2.25	3.00	2.25
Commercial/Industrial Units	0.00	0.00	0.00	0.00
Sensitive Receptors	0.00	0.00	0.00	0.00
Historic Resources	0.89	0.89	1.00	0.89
Archaeological Resources	0.40	0.40	0.80	1.00
Potential to Encounter Subsurface Contamination	0.00	0.00	0.00	0.00
Subtotal for Developed Environment Criteria	*2.79*	*3.54*	*4.80*	*4.14*
	Natural Environment			
Wetland Resource Areas	0.00	0.00	0.00	0.00
Rare Species Habitat	0.00	0.00	0.00	0.00
Public Water Supplies	0.00	0.00	0.00	0.00
Article 97-Jurisdictional Areas	0.67	0.67	2.00	0.00
Tree Clearing [a]	2.66	2.70	2.72	3.00
Subtotal for Natural Environment Criteria	*3.33*	*3.37*	*4.72*	*3.00*
Total	**6.12**	**6.91**	**9.52**	**7.14**

a. Area of tree clearing includes the areas required for the development of the new onshore substation and access road. The grid interconnection cables contained within an underground concrete duct bank will be installed within the access road to the new onshore substation.

Tables 4-4 and 4-5 provide an overview of how each grid interconnection route option scores with respect to the Developed Environment and Natural Environment, respectively. The grid interconnection route option that has the lowest and highest potential for impact is highlighted in **GREEN** (lowest) and **RED** (highest), respectively. The lowest total weighted score equates to the lowest potential for impact, with emphasis on certain criteria as described above.

Table 4-5 Overview of Developed Environment Scores – Grid Interconnection Route Options

Grid Interconnection Route Option	*Developed Environment*	
	Weighted Score	*Rank*
Grid Interconnection Route Option G1 (Fire Tower Access Road to Oak Street)	2.79	1
Grid Interconnection Route Option G1 – Variant 1 (Fire Tower Access Road to Oak Street)	3.54	2
Grid Interconnection Route Option G2 (Eversource ROW #342)	4.80	4
Grid Interconnection Route Option G3 (Route 6 State Highway Layout to Oak Street)	4.14	3

Table 4-6 Overview of Natural Environment Scores – Grid Interconnection Route Options

Grid Interconnection Route Option	*Natural Environment*	
	Weighted Score	*Rank*
Grid Interconnection Route Option G1 (Fire Tower Access Road to Oak Street)	3.33	2
Grid Interconnection Route Option G1 – Variant 1 (Fire Tower Access Road to Oak Street)	3.37	3
Grid Interconnection Route Option G2 (Eversource ROW #342)	4.72	4
Grid Interconnection Route Option G3 (Route 6 State Highway Layout to Oak Street)	3.00	1

As shown in these tables, Grid Interconnection Route G1 (Fire Tower Access Road to Oak Street) has the lowest (best) weighted developed environment score and second lowest weighted natural environment score. Variant 1 to Route G1 scored second in weighted developed environment score and third with respect to natural environment. Grid Interconnection Route G3 (Route 6 state highway layout) has the third lowest weighted developed environment score and lowest weighted natural environment score, and Grid Interconnection Route G2 (Eversource ROW #342) has the highest (worst) weighted developed and natural environment scores.

4.6 Grid Interconnection Route Options Environmental Considerations

The following sections present a comparison of the environmental considerations along the three grid interconnection route options, including Variant 1 proposed for Grid Interconnection Route G1.

4.6.1 Developed Environment Criteria

As identified in Tables 4-2 and 4-3 with respect to the developed environment:

- No commercial or industrial units with parcels directly abutting any of the grid interconnection route options were identified;

- No sensitive receptors with parcels directly abutting any of the grid interconnection route options were identified; and
- No sites on or within 300 feet of a grid interconnection route option where a documented release of oil and/or hazardous materials occurred or where past land uses potentially resulting in contamination have been documented in the BWSC database, pursuant to the MCP (310 CMR 40.0000), were identified.

As such, the remaining developed environment criteria by which the three grid interconnection route options were evaluated included:

- Residential units;
- Historic resources; and
- Archaeological resources.

Residential Units

Residential land uses consist of single- and multi-family housing units, including apartments and condominiums. The Company tallied the total number of units within parcels identified as residential directly abutting the routes. The results are presented below in Table 4-7. No multi-family housing units were identified along any of the routes.

Table 4-7 Number of Residential Units Adjacent to each Grid Interconnection Route Option

Route	*Residential Units*
Grid Interconnection Route Option G1 (Fire Tower Access Road to Oak Street)	2
Grid Interconnection Route Option G1 – Variant 1 (Fire Tower Access Road to Oak Street)	3
Grid Interconnection Route Option G2 (Eversource ROW #342)	4
Grid Interconnection Route Option G3 (Route 6 State Highway Layout to Oak Street)	3

The three grid interconnection route options abut a similar number of parcels with residential housing units. Grid interconnection route option G1 (Fire Tower Access Road to Oak Street) directly abuts two residential units along its route, G3 (Route 6 State Highway Layout) G1-Variant 1 abuts three residential units, and G2 (Eversource ROW #342) abuts four residential units. The potential for temporary construction impacts to residential units is effectively the same for each route. As described in Analysis Section 5, construction period impacts from the Project will be spatially constrained and temporary. Appropriate construction management and mitigation measures will avoid and minimize impacts to residences related to air quality, noise, and traffic congestion (see Analysis Sections 5.3.14, 5.3.12.6, and 5.3.9.4, respectively).

Historic and Archaeological Resources

As described in Analysis Section 5.3.10, the Project is subject to review by the MHC in compliance with M.G.L. Chapter 9, Sections 26-27C as amended by Chapter 254 of the Acts of 1988 (950 CMR 71.00) known as “State Register Review”, and Section 106 of the National Historic Preservation

Act. The Project undertook surveys to identify historic resources, including above-ground historic resources and recorded archaeological sites, within and near the onshore routing alternatives. The term Historic Resources as used herein includes properties listed or eligible for listing on the National Register of Historic Places, properties on the Massachusetts State Register of Historic Places, and properties included in the Inventory of Historic and Archaeological Assets of the Commonwealth. Historic architectural resources located along the grid interconnection routes are shown on Figure 4-4. Locations of recorded archaeological sites have been included in the scoring analysis, but the locations themselves are considered confidential by MHC and applicable federal agencies to protect the resources' integrity.

As described above, if a grid interconnection route option passes through an Area or District with multiple parcels, then the Area or District is counted once and the parcels within the Area or District directly abutting the grid interconnection route option are counted as well (but non-abutting parcels are not counted). All three grid interconnection route options are located entirely within the Old Kings Highway Regional Historic District. As all three grid interconnection route options are located entirely within the same regional historic district, the difference between the grid interconnection routes options is the number of directly abutting parcels along each route (see Table 4-8).

Based on a preliminary assessment performed by the Company's archaeology consultant, the Public Archaeology Laboratory (PAL), the general area surrounding the Project routes has been assigned moderate to high sensitivity for unrecorded archaeological resources. Grid interconnection route options G2 and G3 pass through similar length of areas identified as having moderate or high sensitivity for archaeological resources (see Table 4-8). Grid interconnection Route G1 (Fire Tower Access Road to Oak Street) passes through the shortest length of area identified as having moderate or high sensitivity for archaeological resources. G1 is also the shortest route (approximately 0.4 mile) compared to G2 and G3 that have a total length of approximately 0.6 mile.

Table 4-8 Historic and Archaeological Resources Located Along each Grid Interconnection Route Option

Route	*# of Historic Resources*	*Archaeological Sensitive Areas (length)*
Grid Interconnection Route Option G1 (Fire Tower Access Road to Oak Street)	16	0.2
Grid Interconnection Route Option G1-Variant 1 (Fire Tower Access Road to Oak Street)	16	0.2
Grid Interconnection Route Option G2 (Eversource ROW #342)	18	0.4
Grid Interconnection Route Option G3 (Route 6 State Highway Layout to Oak Street)	16	0.5

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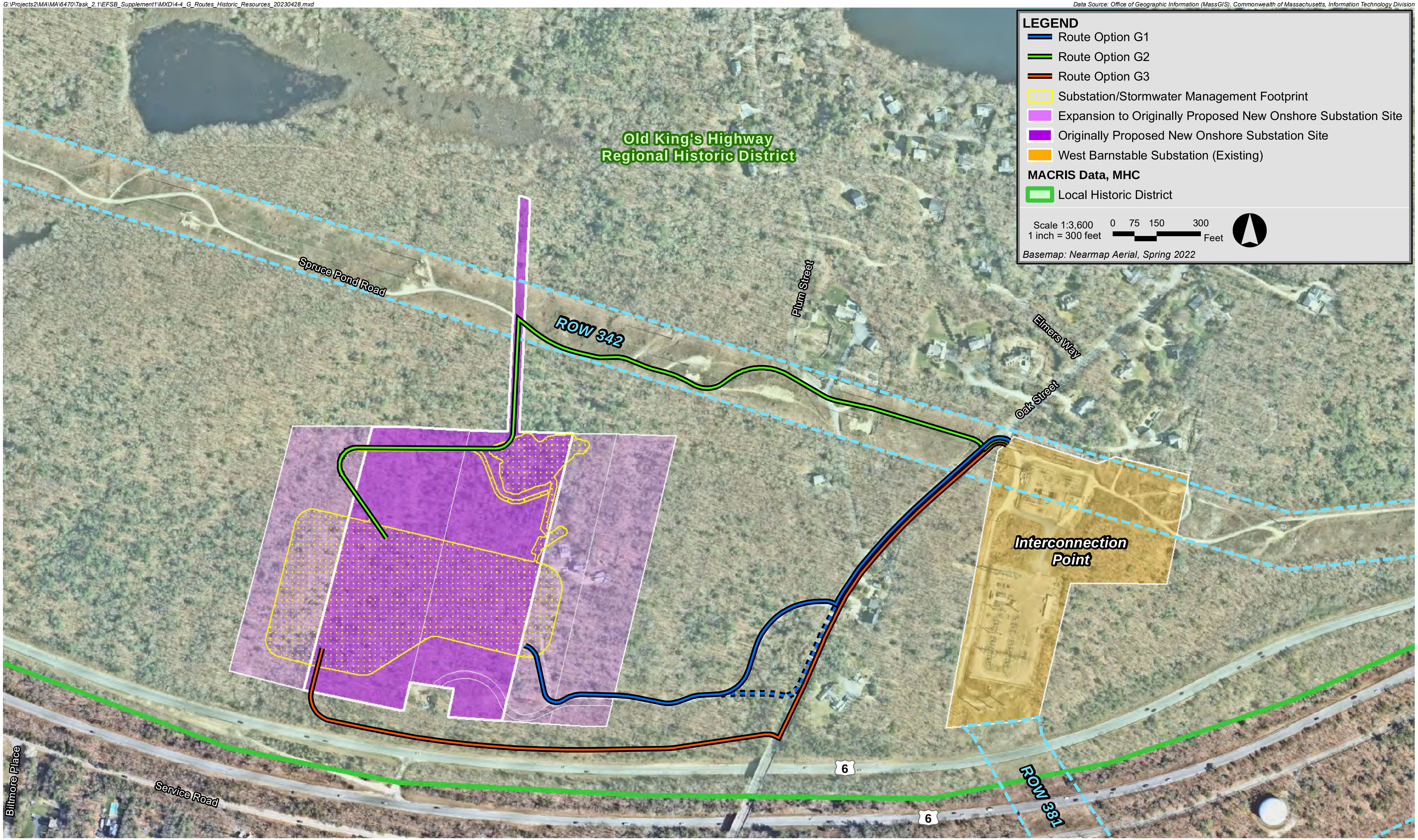
Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



New England Wind 2 Connector Project

Figure 4-4

Grid Interconnection Route Options – Historic Resources (MACRIS Data, MHC)

As noted above, portions of the three grid interconnection route options will be constructed in previously disturbed areas (i.e., within public roadway layouts or within existing access roads). These previously disturbed areas have been modified by construction of the road, and it is unlikely that natural/undisturbed soils or potentially significant unrecorded intact archaeological deposits would be located below or immediately adjacent to them. In general, it would be expected that unrecorded archaeological resources would not be found in previously disturbed roadway layouts. As the Project involves construction of an underground duct bank in existing public roadways, temporary construction activities will temporarily affect the appearance of existing roads near historic properties. However, the effect will be limited to excavation, restoration, and resurfacing of existing roadway layouts. No adverse impacts to above-ground historic properties are anticipated as a result of installation of the underground duct bank within existing public roadway layouts. Construction and excavation for the proposed onshore duct bank will comply will all pertinent codes and regulations for such work to ensure no damage occurs to adjacent properties.

Where 20-foot-wide access roads and underground grid interconnection duct banks will be constructed, tree removal and tree trimming will be required. For grid interconnection route option G1 (Fire Tower Access Road to Oak Street), the existing Fire Tower Access Road will be improved, and the clearing of an entirely new corridor will not be required. Additionally, a forested vegetative buffer will remain in all compass directions and therefore potential visual impacts on historic properties due to clearing are expected to be minimal. For grid interconnection route option G1-Variant 1 (Fire Tower Access Road to Oak Street), the existing Fire Tower Access Road will be improved up to a point on the Kuhn Property where a new corridor will be required where the variant deviates from the existing road out to Oak Street. The 20-foot-wide access road associated with grid interconnection route option G2 (Eversource ROW #342) will require tree and vegetation removal along the approximate 40 foot wide “panhandle” as well as limited tree and vegetation removal on adjacent properties to the east and west of the “panhandle” for construction of the access road. After construction, cleared areas beyond the 20-foot-wide access road will be seeded and allowed to re-vegetate. The clearing of the “panhandle” will result in a new cleared corridor, with views of the new onshore substation from the north within Eversource ROW #342, the Spruce Pond Conservation Area, and the Falcon Road Conservation Area. Existing surrounding forested areas will remain and views of this new corridor from the east, west and south will be screened from view by the remaining forested areas. Grid interconnection route option G3 (Route 6 State Highway Layout) will require the clearing of a new approximately 20 foot wide corridor north of Route 6 up to the intersection with Oak Street for the new proposed access road and grid interconnection duct bank. The vegetative visual buffer between historic properties and the new onshore substation could be reduced and the visual landscape could be altered.

4.6.2 Natural Environment Criteria

None of the following natural environmental criteria were identified along or adjacent to any of the grid interconnection route options:

- Wetland Resource Areas;
- Rare Species Habitat; and
- Public Water Supplies including MassDEP Zone I and II areas and IWPAs.

The natural environmental criteria by which the three grid interconnection route options were evaluated included:

- Article 97-jurisdictional land; and
- Tree clearing.

Article 97-jurisdictional Land

Article 97 lands have been acquired for conservation purposes and are protected under Article 97 of the Amendments to the Massachusetts Constitution. Construction could potentially result in temporary impacts to Article 97 open space areas. Each distinct open space area protected under Article 97 crossed was identified using MassGIS data. Permanent change of use or a disposition of land protected under Article 97 (including underground easements) require legislative approval under Article 97 of the Massachusetts constitution.

Figure 4-2 illustrates protected open spaces along the three grid interconnection route options. Table 4-9 summarizes the number of parcels protected under Article 97 that would be impacted by each grid interconnection route option. Table 4-1 identifies area of disturbance within each Article 97 parcel for access road/grid interconnection development.

Table 4-9 Number of Article 97 parcels crossed by each Grid Interconnection Route Option

Route	***Number of Article 97 parcels impacted***
Grid Interconnection Route Option G1 (Fire Tower Access Road to Oak Street)	1
Grid Interconnection Route Option G1-Variant 1 (Fire Tower Access Road to Oak Street)	1
Grid Interconnection Route Option G2 (Eversource ROW #342)	3
Grid Interconnection Route Option G3 (Route 6 State Highway Layout to Oak Street)	0

Grid interconnection route option G3 (Route 6 State Highway Layout) does not require crossing any Article 97 protected open space, conservation, or recreational lands. Grid interconnection route option G1 (Fire Tower Access Road) and G2 (Eversource ROW #342) will result in temporary impacts associated with vegetation removal and cable installation and permanent impacts associated with the access road to 1 and 3 parcels, respectively.

G1, G1-Variant 1, and G3 will be located adjacent to one parcel mapped as Article 97 lands (Parcel 195-027). This parcel is owned by the Town of Barnstable and managed by the Barnstable Conservation Commission. An access road runs through Parcel 195-027 between Plum Street to the west and Oak Street to the east. Construction of G1 and G3 will have no impacts to the use of this conservation area during construction. This parcel would be crossed by G2 as described below.

Grid interconnection route option G1 and G1-Variant 1 (Fire Tower Access Road) would cross one parcel protected under Article 97 between the new onshore substation and Oak Street (Parcel 195-009, Kuhn Property) (see Figure 4-2). As described in Section 4.1.1 above, the existing Fire Tower Access Road would be improved with gravel surfacing and widened to approximately 20 feet along its entire length (see Attachment 2). Additional grading and selective tree removal and tree trimming would also be required to accommodate the 20-foot-wide gravel access road (see Attachment 2). Following construction, cleared areas beyond the 20-foot-wide access road will be seeded and allowed to re-vegetate. The grid interconnection cables would be buried within the 20-foot-wide access road. Grid interconnection route option G1 (Fire Tower Access Road) will result in approximately 0.34 acres of temporary and permanent impacts to the Kuhn Property (Parcel 195-009, Kuhn Property) associated with widening the existing Fire Tower Access Road to approximately 20 feet along its entire length and installing the underground 345-kV grid interconnection duct bank within the 20-foot-wide access road.

Grid interconnection route option G2 (Eversource ROW #342) would impact three parcels protected under Article 97. This grid interconnection route option would exit the substation to the north and follow the approximately 20-foot-wide, gravel detention basin access road until it reached the approximately 40-foot wide “panhandle” where it would then follow the panhandle north to existing Eversource ROW #342. The “panhandle” does not include an existing access road and construction of this route would require tree clearing and grading on topographically challenging terrain from the new onshore substation to Eversource ROW #342, requiring limited grading and tree and vegetation removal on two protected parcels that are part of the Spruce Pond Conservation Area owned by the Town of Barnstable and managed by the Conservation Commission (see Attachment 2). Following construction, cleared areas beyond the 20-foot-wide access road will be seeded and allowed to re-vegetate. Grid interconnection route option G2 would not result in a permanent disposition of Article 97 lands on the two parcels adjacent to the “panhandle.” Along grid interconnection route option G2, the buried interconnection cables will cross Parcel 195-027 within the existing Eversource ROW #342 and existing access road that runs through the parcel between Plum Street and Oak Street. As such, this parcel of Article 97 land that would be crossed, currently exists in an altered and developed state as an active, maintained access road and utility easement and would continue to do so following construction of the underground duct bank.

Tree Clearing

Naturally vegetated areas containing a mature forest canopy provide habitat for various wildlife species and can provide visual screening. Routes that minimize tree clearing impacts are preferred.

The combined area of tree clearing required for each of the substation/access road/grid interconnection route options was calculated based on the preliminary engineering limits of work for the substation and each access road/grid interconnection route but excluding non-forested areas such as at road crossings, cleared areas, and ROW access roads. The results are presented below in Table 4-10.

Table 4-10 Total Estimated Forested Area to be cleared for the Substation/Access Road/Grid Interconnection Routes

Substation/Access Road/Grid Interconnection Route	*Estimated Forested Area to be Cleared (acres)*
Substation/Access Road/Grid Interconnection Route Option G1 (Fire Tower Access Road to Oak Street)	13.5
Substation/Access Road/Grid Interconnection Route Option G1-Variant 1 (Fire Tower Access Road to Oak Street)	13.7
Substation/Access Road/Grid Interconnection Route Option G2 (Eversource ROW #342)	13.8
Substation/Access Road/Grid Interconnection Route Option G3 (Route 6 State Highway Layout to Oak Street)	15.2

In all cases, tree removal will be required for development of the new onshore substation. Underground installation of the duct bank for the grid interconnection cables within public roadway layouts was assumed to require no tree clearing for scoring purposes; however, depending on final duct bank design, selective tree removal and/or trimming may be required.

Substation/access road/grid interconnection route option G1 (Fire Tower Access Road to Oak Street) would require selective tree removal and tree trimming along the existing Fire Tower Access Road between the proposed onshore substation site and Oak Street in order construct the upgraded 20-foot-wide gravel access road and to install the underground 345-kV grid interconnection duct bank.

Substation/access road/grid interconnection route option G1-Variant 1 (Fire Tower Access Road to Oak Street) would require selective tree removal and tree trimming along the existing Fire Tower Access Road between the proposed onshore substation site and the point it deviates from the existing access road and crosses the Kuhn Property to Oak Street in order construct the upgraded 20-foot-wide gravel access road and to install the underground 345-kV grid interconnection duct bank.

Substation/access road/grid interconnection route option G2 (Eversource ROW #342) would require tree removal and tree trimming along the approximately 40-foot wide “panhandle” and adjacent properties to the east and west of the “panhandle.” Vegetation and tree trimming and removal along certain undeveloped portions of the existing Eversource ROW would also be required.

Substation/access road/grid interconnection route option G3 (Route 6 State Highway Layout to Oak Street) would require construction of a new 20-foot-wide gravel access road within the northern portion of the existing Route 6 State Highway Layout from the proposed onshore substation site to Oak Street. Installation of a new access road within the SHLO would require tree removal and tree trimming. The grid interconnection cables would be installed within the new 20-foot-wide gravel access road.

Substation/access road/grid interconnection route option G1 would require the least amount of tree removal as the existing Fire Tower Access Road would be improved and widened with some additional grading and clearing required. Additionally, G1 is the shortest route, and more than half of the route is located along Oak Street. Variant 1 to route G1 would require slightly more tree clearing (13.7 acres compares to 13.5 acres for G1). Substation/access road/grid interconnection route options G2 would require slightly more tree clearing than G1 or G1-Variant 1 (13.8 acres compared 13.5 and 13.7 acres, respectively). G3 (Route 6 State Highway Layout) would require the most tree clearing, 15.2 acres, and would result in a new cleared corridor between Route 6 and the substation parcels.

The Company will avoid tree removal and/or trimming to the maximum extent practicable. Any vegetation removal will be completed in accordance with all applicable state and local laws and regulations. In all cases, following construction, cleared areas beyond the 20-foot-wide access road will be seeded and allowed to re-vegetate.

Summary of Environmental Impacts

Table 4-11 provides a summary comparison for each applicable criterion for each grid interconnection route option.

Table 4-11 Raw, Unweighted Environmental Summary of Grid Interconnection Route Options

Scoring Criteria	*Grid Interconnection Route Option G1 (Fire Tower Access Road)*	*Grid Interconnection Route Option G1-V1 (Fire Tower Access Road)*	*Grid Interconnection Route Option G2 (Eversource ROW #342)*	*Grid Interconnection Route Option G3 (Route 6 SHLO)*
Route Length (miles)	0.4	0.4	0.6	0.6
Residential Units (unit count)	2	3	4	3
Historic Resources (count)	16	16	18	16
Archaeological Resources (miles)	0.2	0.2	0.4	0.5
Article 97-Jurisdictional Areas (parcel count)	1	1	3	0
Tree Clearing (acres) [a]	13.5	13.7	13.8	15.2

a. Area of tree clearing includes the areas required for the development of the new onshore substation and access road. The grid interconnection cables contained within an underground concrete duct bank will be installed within the access road to the new onshore substation.

4.7 Conclusion and Selection of the Preferred Grid Interconnection Route and Noticed Alternative Grid Interconnection Route

The Company objectively and comprehensively assessed the three grid interconnection route options. Based on the evaluation performed, the Company selected Grid Interconnection Route G1 (Fire Tower Access Road to Oak Street) and/or Option G1-Variant 1 as the Preferred Grid Interconnection Route. Grid Interconnection Route Option G1, including its Variant 1, was selected as the Preferred Grid Interconnection Route because it is the shortest of all the routes, abuts the fewest number of residences, would result in the least amount of vegetation clearing, and would meet the Project timeline for obtaining necessary property rights and approvals.

Grid Interconnection Route G2 (Eversource ROW #342) was selected as the Noticed Alternative because it would require fewer acres of tree clearing than Grid Interconnection Route G3 and tree clearing for Grid Interconnection Route G2 would be located within existing corridors that are already partially cleared (clearcut electrical easement within 40-foot-wide "panhandle" and Eversource ROW #342), and although it would impact the most parcels under Article 97 jurisdiction, the single parcel that would be crossed, would be crossed within the portion of the parcel that currently exists in an altered and developed state as an active, maintained access road and utility easement (which easement predated the conservation status of that parcel) and would continue to do so following construction of the underground duct bank consistent with existing land uses (existing utility ROW with access road). Grid Interconnection Route G3 would require clearing of an entirely new corridor approximately 20 to 55 feet wide depending on grading for the access road and grid interconnection cables within the Route 6 State Highway Layout. In addition, the estimated timeline anticipated to obtain the necessary rights and approvals from MassDOT for Grid Interconnection Route G3 would not meet the Project schedule. Further, development within the State Highway Layout poses additional permitting and design challenges. MassDOT's Utility Accommodation Policy on State Highway Right of Way (May 2013) (the Policy) regulates utility facilities along, across, over, under, or on the ROW of all major highways and other transportation facilities and properties owned or under the jurisdiction of MassDOT, including the fully controlled access highway Route 6. Longitudinal installations of utilities within fully controlled access highways are specifically prohibited in Chapter 6, Section B(4)(a). Chapter 6, Section B(4)(a) further provides that exceptions may be allowed when there are no alternatives as specified in Chapter 8.C, but "[w]hen such installations are allowed… the utility facility shall not be installed or serviced by direct access from the fully controlled access roadways or connecting ramps." Accordingly, Grid Interconnection Route Option G3 would need to be sited between the edge of the paved way and the boundary of the state highway layout, with access entirely separate from the highway and its interchanges. Even assuming that MassDOT would grant an exception from the Policy, this would necessitate greater land disturbance than either of the two alternatives under consideration. In addition, it is far from certain that MassDOT would grant an exception from the Policy, since the Project has viable alternatives to using Route 6 State Highway Layout.

Grid Interconnection Routes G2 and G3 are the same length and are similar with respect to number of residences each route option abuts (4 and 3, respectively), number of abutting historic properties (18 and 16, respectively), and length along archaeologically sensitive areas (0.4 and 0.5 mile, respectively). As such, the incremental environmental impacts within the existing Eversource ROW #342 were determined to have a modest environmental advantage over Grid Interconnection Route G3 within MassDOT Route 6 State Highway Layout and Grid Interconnection Route G3 was not chosen as the Preferred or Noticed Alternative Interconnection Route.

Section 5.0

Onshore Substation Operational Noise Analysis

5.0 ONSHORE SUBSTATION OPERATIONAL NOISE ANALYSIS

As described in Section 2.1, the Company has site control of eight privately owned parcels west of Oak Street in West Barnstable. Of the eight parcels, four of the parcels will be developed with the new revised onshore substation. The proposed revised onshore substation will be sited primarily in the southern and central portions of those four parcels (see Attachment 2 and Figure 2-1). An existing single-family residence located on one of the parcels that will be developed for the revised onshore substation will be removed.

As part of the environmental analysis and permitting effort, Epsilon Associates, Inc. (Epsilon)conducted a sound-level impact assessment for the operation of the revised onshore substation. The operational sound-level impact assessment included a baseline sound monitoring program to measure existing ambient sound levels in the vicinity of the proposed onshore substation site, computer modeling to predict future sound levels when the onshore substation is operational, and a comparison of predicted sound levels with applicable noise criteria.

5.1 Summary

An eight-day baseline ambient sound survey was conducted under defoliate conditions in December of 2022; survey results are discussed in Section 5.4. Existing ambient sound levels in the vicinity of the proposed onshore substation are heavily influenced by traffic noise from Route 6, a four-lane, limited access, divided highway.

As described in Analysis Sections 1.3.4 and 5.5.4, the proposed onshore substation is a 275 to 345 kV step-up design. Gas Insulated Switchgear (GIS) was selected, and the design also includes reactive compensation equipment appropriate for the length of the underground/undersea cabling. Computer modeling, using the proprietary Cadna/A software, was performed to predict sound levels produced by the operating onshore substation. The results of this modeling, in combination with the baseline ambient survey data, were then used to assess potential sound level increases at nearby residential properties and other receptors. The MassDEP Noise Policy, which limits a project-related sound level increase above the ambient sound measured at the property line and at the nearest residences to 10 dBA or less and prohibits ‘pure tone’ conditions, provided context for this operational sound-level impact assessment. The results of the operational sound-level impact assessment show a maximum modeled increase over the existing ambient sound level at a residential property is 7 dBA based on conservatively low established ambient levels. Because of the proximity of Route 6, daytime ambient sound levels in the vicinity of the onshore substation are typically much higher than the levels used in the evaluation. Accordingly, impacts will be much lower during these times. It should be noted that the measured ambient sound levels and modeled substation sound levels are outdoor sound levels. Sound levels inside a residence will typically be around 10 dBA lower (or more with windows closed).

Octave band modeling of onshore substation operations demonstrates that the onshore substation will not cause pure tones, as defined by MassDEP, at nearby residential properties.

An introduction to the general sound terms used in this assessment is provided in Section 5.2, Massachusetts regulatory policy with respect to acoustics is summarized in Section 5.3, baseline sound measurement procedures and ambient sound levels in the vicinity of the onshore substation site are presented in Section 5.4, onshore substation components, along with modeling methodologies and results, are described in Section 5.5, and an evaluation of future total sound levels is provided in Section 5.6.

5.2 Sound Terminology

There are several ways in which sound levels are measured and quantified. All of them use the logarithmic decibel (dB) scale. The decibel scale is logarithmic to accommodate the wide range of sound intensities found in the environment. A property of the decibel scale is that the sound pressure levels of two or more separate sounds are not directly additive. For example, if a sound of 50 dB is added to another sound of 50 dB, the total is only a 3-decibel increase (53 dB), which is equal to doubling in sound pressure, but not equal to a doubling in decibel quantity (100 dB). Thus, every 3-dB change in sound level represents a doubling or halving of sound pressure. The human ear does not perceive changes in the sound pressure level as equal changes in loudness. Scientific research demonstrates that the following general relationships hold between sound level and human perception for two sound levels with the same or very similar frequency characteristics[9]:

- A 3-dB increase or decrease results in a change in sound that is just perceptible to the average person;
- A 5-dB increase, or decrease is described as a clearly noticeable change in sound level; and
- A 10-dB increase (or decrease) is described as twice (or half) as loud.

Another mathematical property of decibels is that if one source of sound is at least 10 dB louder than another source, then the total sound level is simply the sound level of the higher-level source. For example, a sound source at 60 dB plus another sound source at 47 dB is equal to 60 dB.

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[9] Bies, David, and Colin Hansen. 2009. *Engineering Noise Control: Theory and Practice*, 4th Edition. New York: Taylor and Francis.

A sound level meter (SLM) that is used to measure sound is a standardized instrument.[10] It contains "weighting networks" (e.g., A-, C-, and Z-weightings) to adjust the frequency response of the instrument. Frequencies, reported in Hertz (Hz), are detailed characterizations of sounds, often addressed in musical terms as "pitch" or "tone." The most commonly used weighting network is the A-weighting because it most closely approximates how the human ear responds to sound at various frequencies. The A-weighting network is the accepted scale used for community sound level measurements; therefore, sounds are frequently reported as detected with a sound level meter using this weighting. A-weighted sound levels emphasize middle frequency sounds (i.e., middle pitched – around 1,000 Hz), and de-emphasize low and high frequency sounds. These sound levels are reported in decibels designated as "dBA". The C-weighting network has a nearly flat response for frequencies between 63 Hz and 4,000 Hz and is noted as dBC. Z-weighted sound levels are measured sound levels without any weighting curve and are otherwise referred to as "unweighted". Sound pressure levels for some common indoor and outdoor environments are shown in Figure 5-1.

Because the sounds in our environment vary with time, they cannot simply be described with a single number. Two methods are used for describing variable sounds. These are exceedance levels and the equivalent level, both of which are derived from some number of moment-to-moment A-weighted sound level measurements. Exceedance levels are values from the total amplitude distribution of all the sound levels observed during a measurement period. Exceedance levels are designated L_n, where n can have a value between 0 and 100 in terms of percentage. Several sound level metrics that are commonly reported in community sound assessments are described below.

- L_{90} is the sound level exceeded 90 percent of the time during the measurement period. The L_{90} is close to the lowest sound level observed. It is essentially the same as the residual sound level, which is the sound level observed when there are no obvious nearby intermittent sound sources.

- L_{eq}, the equivalent level, is the level of a hypothetical steady sound that would have the same energy (*i.e.,* the same time-averaged mean square sound pressure) as the actual fluctuating sound observed. The equivalent level is designated L_{eq} and is typically A-weighted. The equivalent level represents the time average of the fluctuating sound pressure, but because sound is represented on a logarithmic scale and the averaging is done with linear mean square sound pressure values, the L_{eq} is mostly determined by loud sounds if there are fluctuating sound levels.

5.3 Noise Regulations

This section addresses federal, state, and local noise regulations.

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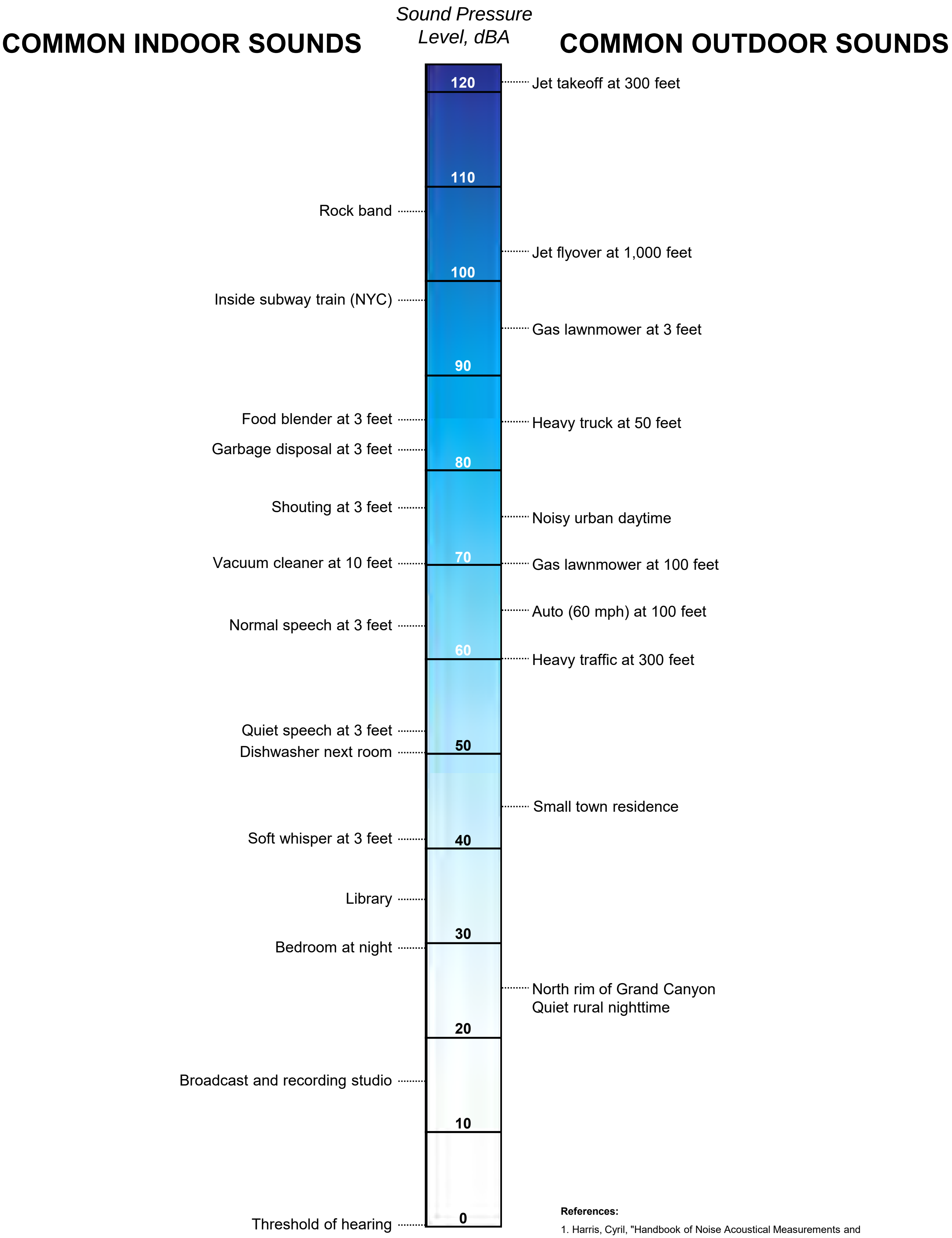
[10] *American National Standard Electroacoustics – Sound Level Meters – Part 1: Specifications,* ANSI S1.4-2014 (R2019), published by the Standards Secretariat of the Acoustical Society of America, Melville, NY.



References:

1. Harris, Cyril, "Handbook of Noise Acoustical Measurements and Noise Control", p 1-10., 1998
2. "Controlling Noise", USAF, AFMC, AFDTC, Elgin AFB, Fact Sheet, August 1996
3. California Dept. of Trans., "Technical Noise Supplement", Oct, 1998

Figure 5-1

Common Indoor and Outdoor Sound Levels

5.3.1 Federal Regulations

There are no federal noise regulations applicable to the proposed onshore substation.

5.3.2 Massachusetts State Regulations

MassDEP has the authority to regulate noise under 310 CMR 7.10, which is part of the Commonwealth's air pollution control regulations. Under MassDEP regulations, noise is considered to be an air contaminant and, thus, 310 CMR 7.10 prohibits "unnecessary emissions" of noise.

For projects requiring a state air permit, MassDEP administers this regulation through its Noise Policy DAQC 90-001, dated February 1, 1990 (see Attachment 6). The Noise Policy limits a source to a 10-dBA increase above the ambient sound measured at the property line for the site and at the nearest residences. "Ambient" is defined as the background A-weighted sound level that is exceeded 90% of the time (L_{90}), measured during equipment operating hours. While the New England Wind 2 Connector does not require a Massachusetts air permit, the MassDEP Noise Policy has been used as a guidepost in environmental reviews conducted by other state offices for other similar projects.

According to MassDEP, "Noise levels that exceed the criteria at the source's property line by themselves do not necessarily result in a violation or a condition of air pollution under MassDEP regulations (see 310 CMR 7.10). The agency also considers the effect of noise on the nearest occupied residence and/or building housing sensitive receptors." The MassDEP Noise Policy provides for further flexibility with respect to non-residential properties. More specifically, "A new noise source that would be located in an area that is not likely to be developed for residential use in the future (e.g., due to abutting wetlands or similarly undevelopable areas), or in a commercial or industrial area with no sensitive receptors may not be required to mitigate its noise impact on those areas, even if projected to cause noise levels at the facility's property line to exceed ambient background by more than 10 dB(A). However, a new noise source that would be located in an area in which housing or buildings containing other sensitive receptors could be developed in the future may be required to mitigate its noise impact in these areas." The Noise Policy interpretation is attached to this report as Attachment 7.

MassDEP's Noise Policy further prohibits "pure tone" conditions where the sound pressure level in one octave band is 3 dB or more than the sound levels in each of the two adjacent octave bands. A qualitative example of a source emitting a "pure tone" is a fan with a bad bearing that is producing an objectionable squealing sound.

5.3.3 Local Regulations

The Town of Barnstable General Ordinance contains the following qualitative language regulating noise in Chapter 133-1:

> *It shall be unlawful for any person or persons occupying or having charge of or owning any building, dwelling, structure, premises, shelter, boat or conveyance or any part thereof in the Town, to cause or suffer to allow any unnecessary, loud, excessive or unusual noises in the operation of any radio, phonograph or other mechanical or electronic sound making device or instrument, or reproducing device or instrument, or in the playing of any band, orchestra, musician or group of musicians, or in the use of any device to amplify the aforesaid, or the making of loud outcries, exclamations or other loud or boisterous noises or loud and boisterous singing by any person or group of persons or in the use of any device to amplify the aforesaid noise, where the noise is plainly audible at a distance of 150 feet from the building, dwelling, structure, premises, shelter, boat or conveyance in which or from which it is produced. The fact that the noise is plainly audible at a distance of 150 feet from the building, dwelling, structure, premises, shelter, boat, or conveyance from which it originates shall constitute prima facie evidence of a violation of this chapter.*

In lieu of quantitative local limits, the MassDEP Noise Policy will be used to assess the proposed revised onshore substation's sound levels.

5.4 Existing Sound Levels

In December 2022, an 8-day ambient ("background" or "baseline") sound level survey was conducted to characterize the acoustical environment in proximity to the proposed substation site. The survey was conducted under defoliate winter conditions and during a month when recreational/tourist traffic on Cape Cod is at a low ebb (i.e., off-peak season). Existing sound sources during this time included vehicular traffic on Route 6, Oak Street, and Service Road, aircraft flyovers, some residential activity, birds, and wind running through the trees.

5.4.1 Measurement Methodology

The ambient sound measurement program consisted of long-term monitors at two locations in the vicinity of the onshore substation site; these monitors collected approximately eight days of continuous hourly ambient sound level data from Monday, December 5, 2022 to Tuesday, December 13, 2022. Short-term (i.e., 20-minute) measurements were collected at three additional locations in the community during the daytime on Monday, December 5, 2022 (between 2:00 PM and 3:40 PM) and during nighttime hours on Tuesday, December 6, 2022 (between 12:30 AM and 2:15 AM).

All measurements were made at publicly accessible locations or with landowner permission at a height of five feet (1.5 meters) above ground level. Ground level wind speeds were measured on-site at a height of six feet (2 meters). Additional meteorological data from the closest National Weather Service (NWS) station in Hyannis, MA (Barnstable Municipal Airport) provided by the National Centers for Environmental Information (NCEI) were obtained for the duration of the continuous monitoring period and used to determine hourly measurement periods when precipitation was present. The NWS data are included as Attachment 8 to this report.

5.4.2 Measurement Locations

A total of five sound level measurement locations were selected to represent sound levels at the nearest noise-sensitive receptors to the proposed revised onshore substation, including residences to the northeast, east, west, and south of the proposed onshore substation site. These measurement locations are depicted on Figure 5-2 and described below.

- **Location LT1 – Southern Property Line** is located along the southern edge of the proposed revised onshore substation site, at a similar distance from Route 6 as the residences south of Route 6 and Service Road as well as the residence at 550 Oak Street to the east of the site.

- **Location LT2 – Plum Street** is located near the intersection of Spruce Pond Road and Plum Street and the existing Eversource ROW #342 to represent residences northeast of the site.

- **Location ST1 – Oak Street** is located along Oak Street, near 550 Oak Street. This short-term sampling location provides perspective for the residences along Oak Street east of the site.

- **Location ST2 – Minton Lane** is located at the end of Minton Lane, south of the revised onshore substation site. This short-term sampling location provides additional perspective for the residences south of Route 6 and Service Road.

- **Location ST3 – Spruce Pond Conservation Area** is located along Spruce Pond Road and the existing Eversource ROW #342. This short-term location provides perspective for the residential areas to the north and west of the proposed revised onshore substation site.

5.4.3 Measurement Equipment

Larson Davis Model 831 sound level meters, equipped with PCB PRM831 preamplifiers, PCB 377C20 or 377B20 half-inch microphones, and manufacturer-provided windscreens, were used to collect background sound pressure level data. This instrumentation meets the “Type 1 - Precision” requirements set forth in ANSI S1.4 for acoustical measuring devices. The measurement equipment was calibrated in the field before and after the survey with a Larson Davis CAL200

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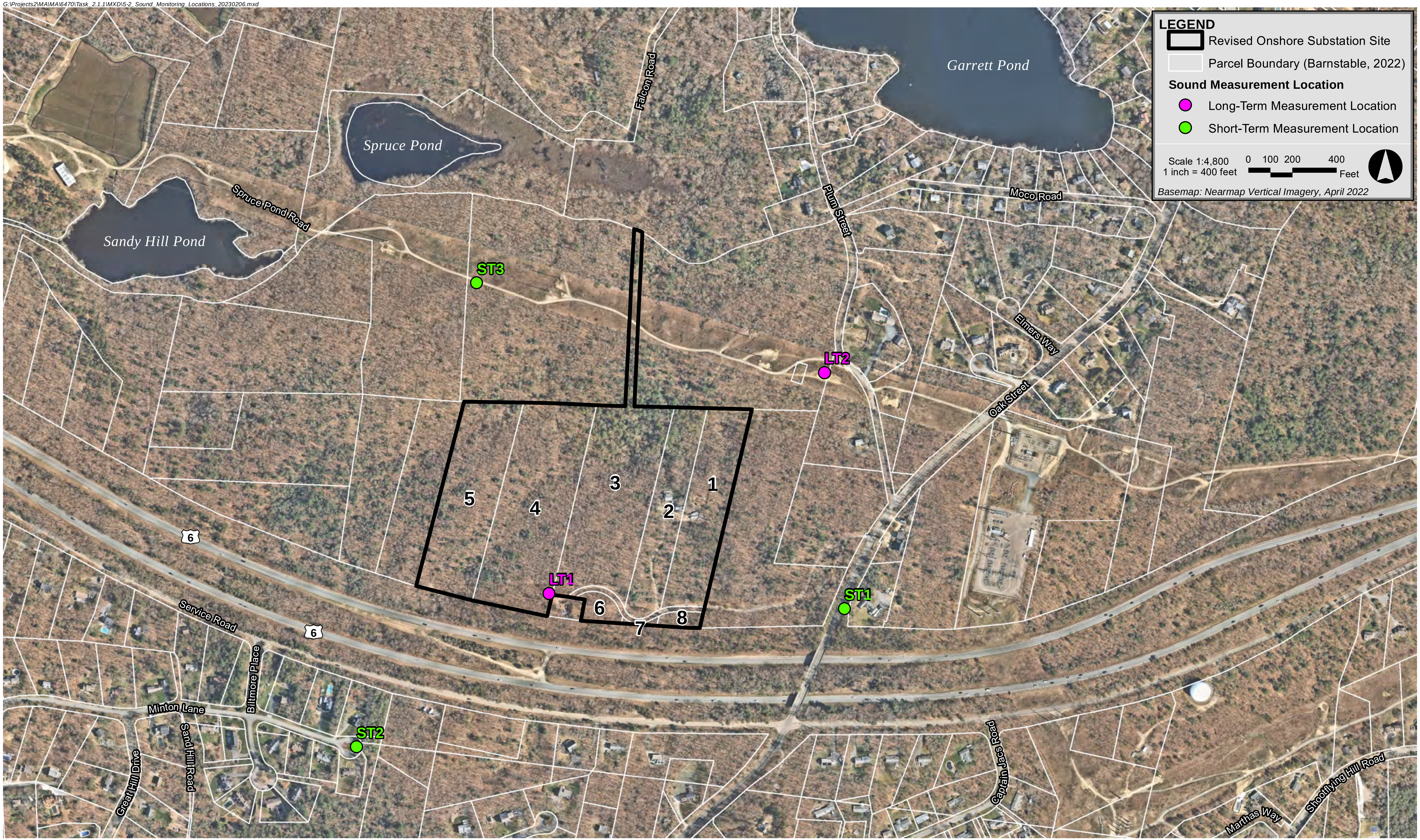

New England Wind 2 Connector Project

AVANGRID Offshore Wind

Figure 5-2

Sound Level Monitoring Locations

acoustical calibrator which meets the standards of IEC 942 Class 1L and ANSI S1.40. Statistical descriptors (e.g., L_{eq}, L_{90}, etc.) were measured for each 1-hour sampling period during the continuous measurements and for 20-minute periods during the short-term measurements. One-third octave band sound levels corresponding to the same datasets were also collected.

Wind speed, wind direction, temperature, and precipitation measurements were made at Location LT1 using an ATMOS 41 weather station and EM60 data logger (manufactured by Meter Group, Inc.). The weather station has a wind speed measurement range of 0 to 30 m/s (67 mph) and an accuracy of ±0.3 m/s (0.67 mph). The wind direction measurement range is 0 to 359 degrees with an accuracy of ±5 degrees. The air temperature measurement range is -50 to 60°C (-58 to 140°F) with an accuracy of ±0.6°C, and the precipitation measurement range is 0 to 400 mm/h with an accuracy of ±5% of the measurement from 0 to 50 mm/h.

5.4.4 Ambient Sound Levels

One-hour A-weighted sound pressure level data (L_{eq} and L_{90}) from continuous ambient monitors at locations LT1 and LT2 are presented in Figure 5-3 and Figure 5-4 respectively, along with periods of precipitation recorded by the NWS and ground level wind speeds recorded on-site. Periods of precipitation were excluded from the analysis using guidance from ANSI S12.18. The average ground-level wind speed did not exceed 5 m/s during any hour during the measurement program; therefore, no data were excluded due to high wind.

A-weighted broadband L_{90} (dBA) values presented in Table 5-1 represent the average of the lowest L_{90} (dBA) sound pressure levels observed each day of the ambient sound measurement program.[11] The octave band L_{90} levels (dB) in Table 5-1 correspond to a representative 1-hour measurement period when the broadband L_{90} value was comparable to the averaged broadband level at that location.

As previously noted, the ambient measurements were taken in December, when traffic volumes on Route 6 are generally at an annual low ebb. As clearly shown on Figure 5-3 and Figure 5-4, there remains a strong diurnal pattern in the L_{90} sound levels at both continuous monitoring locations even during the off-peak season. The lowest ambient sound levels (low to mid 30's) are typically only briefly observed during late overnight hours (generally after midnight) when traffic on Route 6 is minimal. The valid measured residual background (L_{90}) sound levels during the

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[11] The partial day on the front end of the program (December 5) was excluded from the analysis as the quietest part of the day may not have been captured. In addition, precipitation was record on December 7, 10, and 11, which may have impacted the quietest hour, so these dates were also excluded. As such, the data represents the average of the lowest L_{90} (dBA) sound pressure levels from five days.

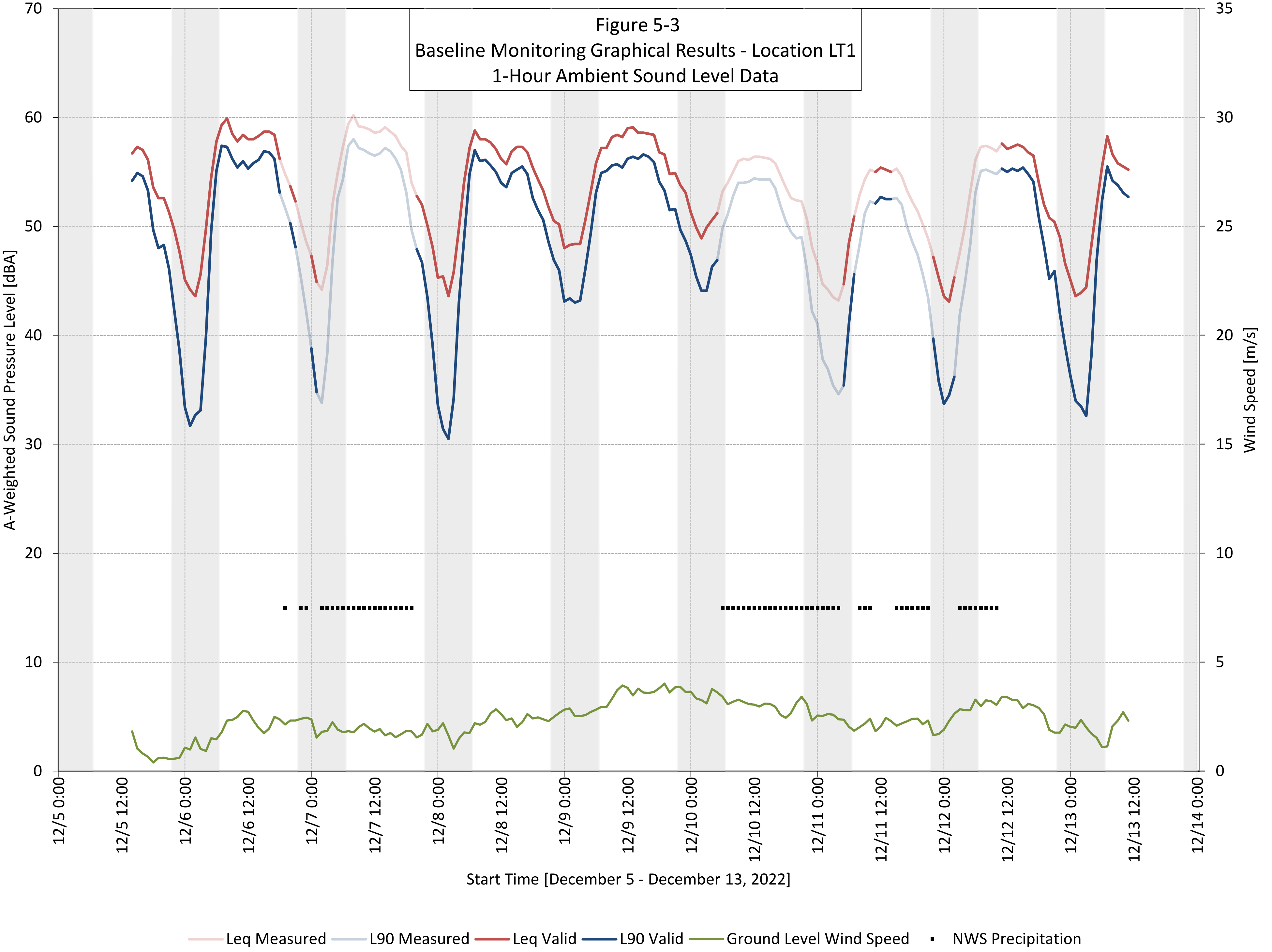

Figure 5-3

Baseline Monitoring Graphical Results - Location LT1

1-Hour Ambient Sound Level Data

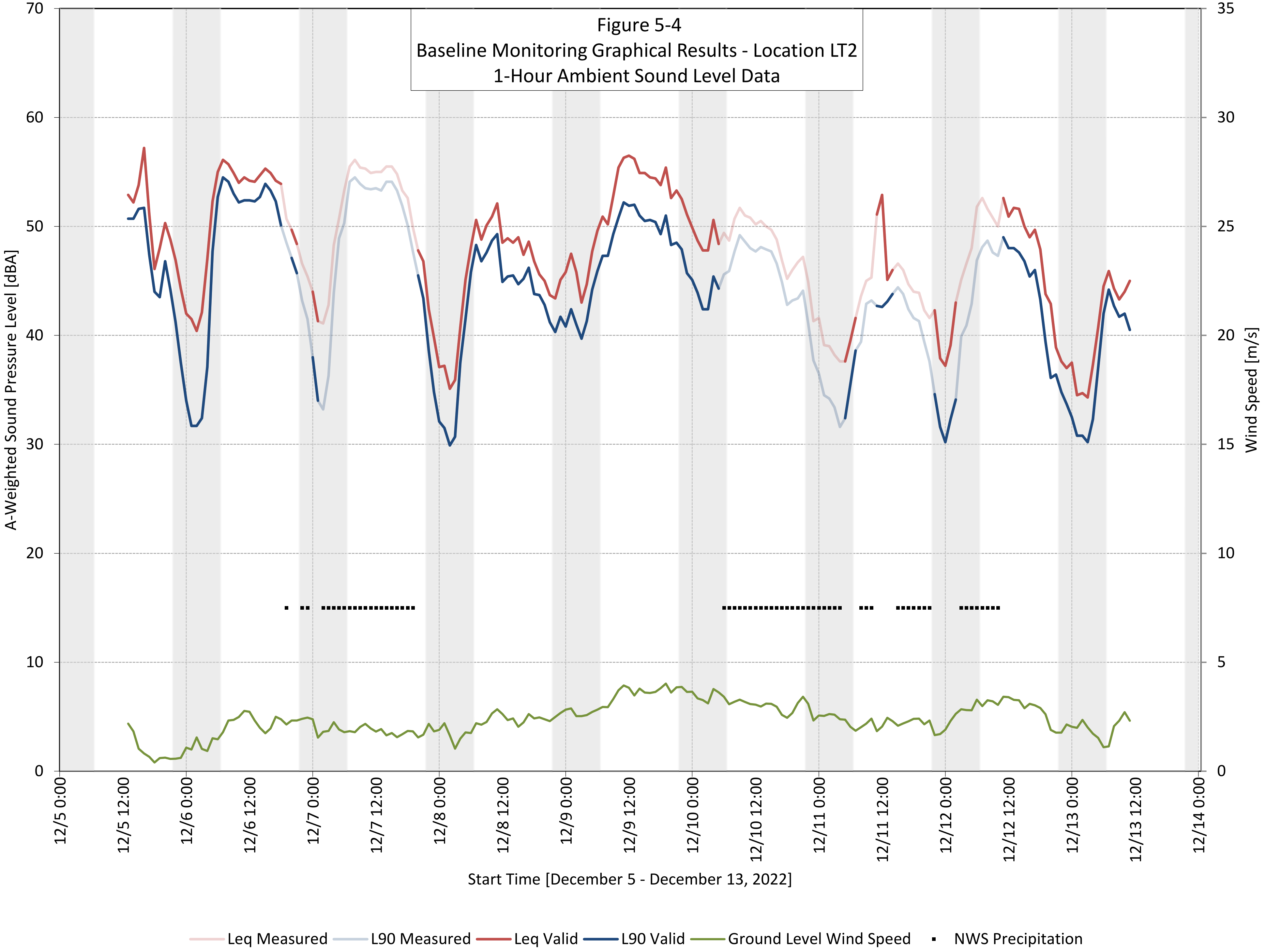

Figure 5-4
Baseline Monitoring Graphical Results - Location LT2
1-Hour Ambient Sound Level Data

daytime[12] ranged from 36 to 57 dBA. The lowest daytime L_{90} sound level of 36 dBA was at Location LT2. The lowest daytime L_{90} sound level at Location LT1, which is approximately 1,000 feet closer to Route 6, was 45 dBA. For additional context, Table 5-2 presents the average of the broadband sound levels (L_{90}) measured during daytime hours at both locations. Octave band spectra, representative of these averages, are also included in the table for reference.

MassDEP-defined pure tones were measured at both long-term monitoring locations during various times of the day from December 5th to December 13th. Pure tones at Location LT1 were measured in the 250 Hz and 1,000 Hz octave bands. Pure tones at Location LT2 were measured in the 125 Hz and 1,000 Hz octave bands. Based on field personnel observations, the pure tones in the 1,000 Hz octave band are likely due to vehicular traffic. The source(s) of the pure tones at 125 Hz and 250 Hz are unknown without further assessment. The representative 1-hour octave band sound levels shown in Table 5-1 do not contain pure tones.

Table 5-1 Average Quietest Long-Term Ambient Sound Level Measurement Summary

Location ID	Broad-band L_{90}[1]	L_{90} Sound Pressure Level by Octave Band Center Frequency (Hz)								
		31.5	63	125	250	500	1k	2k	4k	8k
	dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB
LT1	34	40	39	31	31	30	31	24	17	14
LT2	32	43	40	36	33	31	27	15	10	8

Notes:

1. The average of the sound pressure levels observed during the quietest hour of each day.

Table 5-2 Average Daytime Long-Term Ambient Sound Level Measurement Summary

Location ID	Broad-band L_{90}[1]	L_{90} Sound Pressure Level by Octave Band Center Frequency (Hz)								
		31.5	63	125	250	500	1k	2k	4k	8k
	dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB
LT1	53	57	55	47	47	48	50	44	34	28
LT2	47	53	49	48	42	42	44	36	28	21

Notes:

1. The average of the sound pressure levels observed between 7:00 AM to 10:00 PM of each day.

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[12] 7:00 AM to 10:00 PM

Short-term broadband and octave band sound level data collected at locations ST1, ST2, and ST3 are presented in Table 5-3. The daytime short-term sound levels range from 43 to 56 dBA, and the nighttime short-term sound levels range from 31 to 33 dBA. Table 5-3 reveals that MassDEP-defined pure tones were measured at all three short-term locations during the day which are likely attributable to vehicles based on field personnel observations.

Table 5-3 Short-Term (20-minute) Ambient Sound Level Measurement Summary

Loc. ID	Period	Start Date/ Time	Broad-band L_{90}	L_{90} Sound Pressure Level by Octave Band Center Frequency (Hz)								
				31.5	63	125	250	500	1k	2k	4k	8k
			dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB
ST1	Day	12/5/2022 2:04 PM	56	57	56	50	43	47	54[1]	49	37	26
ST2	Day	12/5/2022 3:20 PM	47	55	53	46	41	41	44[1]	38	26	18
ST3	Day	12/5/2022 2:42 PM	43	51	44	38	34	38	41[1]	32	22	16
ST1	Night	12/6/2022 1:07 AM	31	38	35	29	26	27	26	21	18	14
ST2	Night	12/6/2022 1:43 AM	33	39	37	30	27	27	28	24	23	19
ST3	Night	12/6/2022 12:25 AM	31	38	35	27	22	26	28	21	17	14

Notes:

1. Existing MassDEP-defined pure tone likely attributable to vehicles based on field personnel observations.

5.4.5 Establishment of Ambient Sound Levels for Evaluation

In order to evaluate the proposed revised onshore substation in the context of the MassDEP Noise Policy as described in Section 5.3.2, ambient sound levels were established for each measurement location before application to modeling receptors, i.e., evaluation points. Table 5-4 provides a summary of the ambient sound levels established for all five measurement locations as they will be utilized in the evaluations. Given that the onshore substation is anticipated to operate 24 hours per day at various loads, only the nighttime sound levels from the short-term measurements will be used in the evaluation.

An adjustment has been made to the short-term sound level data, originally presented in Table 5-3. This adjustment accounts for a weekly average of the broadband sound levels based on the sound level measured at a representative long-term location during the same hour of the nighttime short-term measurements.[13] Accordingly, octave band levels were adjusted using the same factor.

Table 5-4 Ambient Sound Levels for Evaluation

Measurement Location ID	Broad-band ANS L_{90}	L_{90} Sound Pressure Level (dB) by Octave-Band Center Frequency (Hz)								
		31.5	63	125	250	500	1k	2k	4k	8k
	dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB
LT1	34[1]	40	39	31	31	30	31	24	17	14
LT2	32[1]	43	40	36	33	31	27	15	10	8
ST1[2]	34	40	38	31	29	30	29	24	21	17
ST2[2]	36	42	39	33	30	30	30	27	26	22
ST3[3]	29	37	33	25	20	24	26	19	15	12

Notes:

1. The average of the sound pressure levels observed during the quietest hour of each day.
2. Includes adjustment factor of 2.6 decibels to account for average sound level based on Location LT1.
3. Includes adjustment factor of -1.7 decibels to account for average sound level based on Location LT2.

5.5 Modeled Sound Levels

5.5.1 Overview of Project Onshore Substation Sound Sources and Noise Controls

As described in Analysis Sections 1.3.4 and 5.5.4, the proposed new onshore substation is a 345-kV GIS design. Its purpose is to step up the voltage in the onshore export cables from 275-kV to 345-kV in preparation for interconnection to the grid at the West Barnstable Substation. The preliminary engineering 275/345 KV GIS Substation Plan Set developed by Stantec is provided in Attachment 2. The proposed substation, including a full-perimeter access road and security fence, will occupy approximately 9.9 acres (see Table 2-2). The four parcels that will be developed for the new revised onshore substation will be partially cleared as a result of Project development. Land and tree clearing will be minimized to the extent practicable and existing forested buffer around the substation will be maintained (see Attachment 2, Drawing Sheet 8).

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[13] Measurement location LT1 is a comparable distance from Route 6 (the primary sound source in the area) as locations ST1 and ST2. The sound level measured at LT1 during the nighttime short-term measurements (12/6/2022 at 1:00 AM) was 2.6 dBA lower than the calculated average minimum L90 at that location. Therefore, this difference was added to the nighttime sound levels at ST1 and ST2 shown in Table 5-4 to account for and approximate an average. Measurement location LT2 is a comparable distance from Route 6 as location ST3. The sound level measured at LT2 during the nighttime short-term measurement (12/6/2022 at 12:00 AM) was 1.7 dBA higher than the calculated average minimum L90 at that location. Therefore, this difference was subtracted from the nighttime sound level at ST3 shown in Table 5-4 to account for and approximate an average.

The primary onshore substation equipment and features included in the sound level model are shown in Figure 5-5. Each of the three static compensators (STATCOM) include an engineered enclosure which houses the STATCOM itself; the necessary ancillary equipment (e.g., transformer, reactor, cooling fan bank) is outside of the enclosure. The 275-kV and 345-kV GIS buildings are centrally located within the substation fence line, west of the STATCOMs. A control room abuts the GIS buildings on the southern side. The balance of the substation equipment (six 275-kV shunt reactors [three 230 MVAR, three 60 MVAR], three 450 MVA main transformers, and three 275-kV harmonic filters) is arranged along the northern and southern portions of the site within the fence line. The overall arrangement was developed using an iterative process which allowed the design team to balance electrical, civil, and acoustical considerations while providing for ready access to all equipment.

Table 5-5 identifies the onshore substation equipment included in the model along with the type or rating, quantity, and the modeled sound power levels for each piece of equipment. Table 5-6 provides a summary of the outdoor STATCOM components included in the sound level model. A-weighted broadband and unweighted octave band sound level data are provided in the tables. Sound power levels for the site yard components were estimated by Epsilon by using data for a similar substation project or by using the MVA rating and methods outlined in the Electric Power Plant Environmental Noise Guide[14] (EEI Noise Guide). Broadband (dBA) sound power levels for the STATCOM components were originally provided by a major electrical equipment manufacturer[15] but modified to reflect sound level reductions as later described. Octave band spectra were estimated by Epsilon based on data from a similar substation project or by using the MVA rating and the EEI Noise Guide. Electrical and mechanical components of the proposed onshore substation, either in the site yard, in the STATCOMs, or contained within site buildings or engineered enclosures, not included in the tables are assumed to be insignificant sources of sound in the community and were excluded from the model.

Further details on the sound power levels for major components used in the acoustical modeling are provided below. For the transformers and iron core shunt reactors, “quieted” equipment served as the starting point. “Quieted,” as defined in the EEI Noise Guide, is 10 dBA below standard sound levels. In many instances, further reductions in equipment sound levels were incorporated in the acoustical modeling as further described and quantified below to reduce off-site operational sound levels. The sound reductions would require modifications to the standard quieted design and will increase the cost of the equipment. In general, the sound levels presented in Tables 5-4 and 5-5 have been shown to be achievable based on a similar substation sound study

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[14] Bolt Beranek and Newman Inc. (1984). *Electric Power Plant Environmental Noise Guide* (2nd ed.). Edison Electric Institute.

[15] A substation EPC firm and specific equipment manufacturers will be selected later in the project development process.

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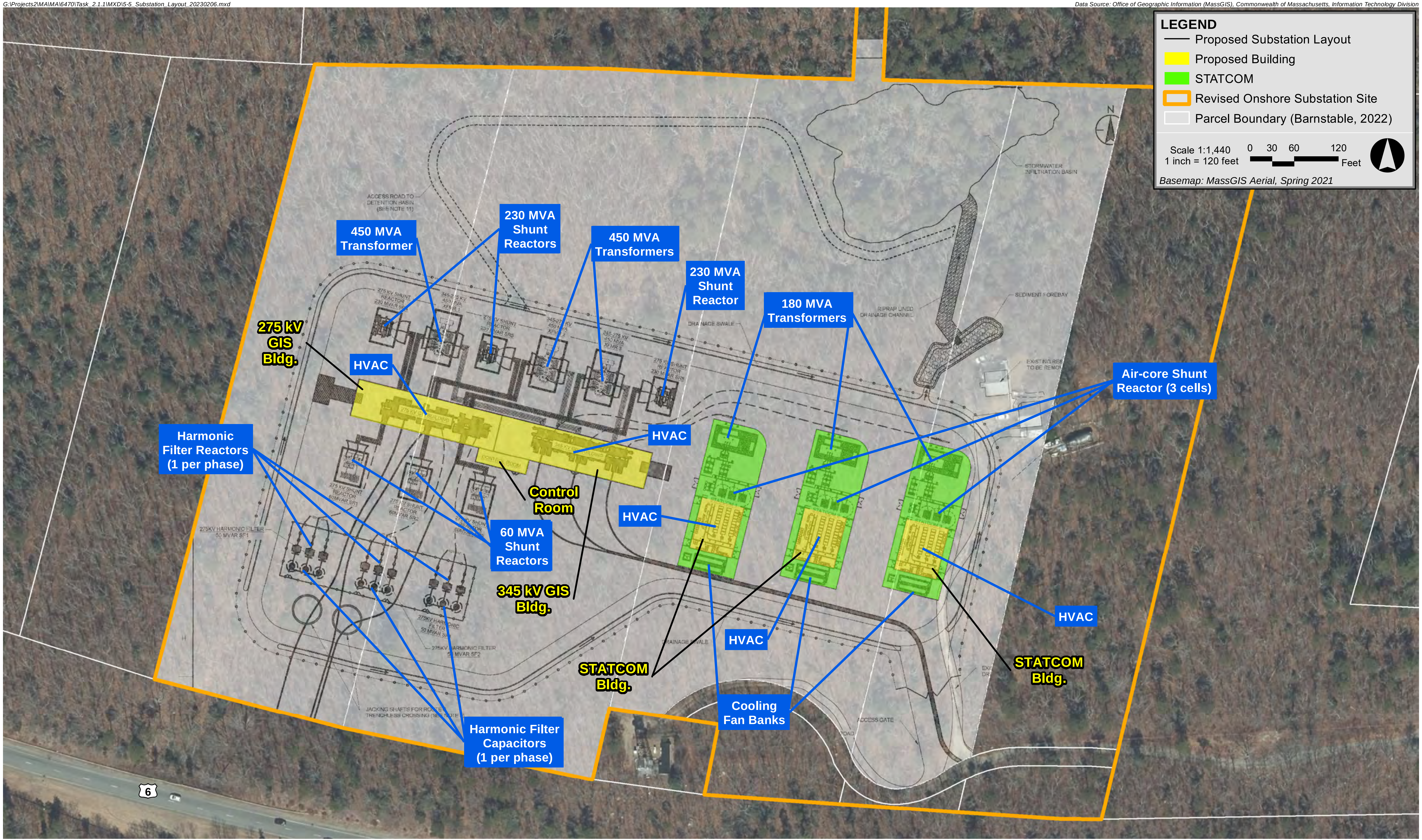
Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



This product is for informational purposes and may not be suitable for legal, engineering, or surveying purposes.

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Figure 5-5
Substation Layout

performed by Epsilon and/or information provided from an engineering, procurement, and construction (EPC) contractor for a similar substation project. The Company will procure low noise equipment as follows:

- **Site yard 450 MVA main transformers** - The main transformers selected for the onshore substation have been modeled with sound power levels that are 17 dBA lower than a standard unit.
- **Site yard 230 MVAR iron core shunt reactors** - Due to similarities (e.g., physical appearance and sound characteristics) in iron core shunt reactors to main transformers, methods set forth in the EEI Noise Guide may be used to approximate sound levels for these units. The 230 MVAR iron core shunt reactors selected for the onshore substation have been modeled with sound power levels that are 16 dBA lower than a standard unit.
- **Site yard 60 MVAR iron core shunt reactors** - The 60 MVAR iron core shunt reactors selected for the onshore substation have been modeled with sound power levels that are 11 dBA lower than a standard unit.
- **Site yard harmonic filter capacitor** - The capacitor selected for the onshore substation has been modeled with sound power levels that are 4 dBA lower than what was provided in original unquieted reference data.
- **Site yard HVAC** - The HVAC units selected for the onshore substation have been modeled with sound power levels that are 6 dBA lower than what was provided in original unquieted reference data.
- **STATCOM air-core shunt reactor** - The air-core shunt reactors selected for the onshore substation have been modeled with sound power levels that are 15 dBA lower than what was provided in original unquieted reference data.
- **STATCOM 180 MVA transformer** - The 180 MVA transformers selected for the onshore substation have been modeled with sound power levels that are 18 dBA lower than what was provided in original unquieted reference data.
- **STATCOM cooling fan bank** - The cooling fan banks selected for the onshore substation have been modeled with sound power levels that are 2 dBA lower than what was provided in original unquieted reference data.
- **STATCOM HVAC** - The HVAC units selected for the onshore substation have been modeled with sound power levels that are 6 dBA lower than what was provided in original unquieted reference data.

Table 5-5 Reference Sound Power Levels - Site Yard Components

Component	Type/ Rating	Qty.	Broad-band	Sound Power Levels (dB) by Octave Band Center Frequency (Hz)								
				32	63	125	250	500	1k	2k	4k	8k
			dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB
Transformer	450 MVA; 345/275kV	3	93	90	96	98	93	93	87	82	77	70
Iron Core Shunt Reactor	230 MVAR; 275kV	3	90	87	93	95	90	90	84	79	74	67
Iron Core Shunt Reactor	60 MVAR; 275kV	3	86	83	89	91	86	86	80	75	70	63
Harmonic Filter Capacitor[1]	50 MVAR; 275kV	9 (1 per phase)	72	-	-	88	38	63	57	28	20	-
Harmonic Filter Reactor[1]	50 MVAR; 275kV	9 (1 per phase)	76	-	47	70	76	76	72	57	-	-
HVAC[1]	Unknown	2	88	-	-	-	-	-	-	-	-	-

Notes:

1. Sound levels in some octave bands were not available.

Table 5-6 Reference Sound Power Levels – STATCOM Components

Component	Type/ Rating	Qty.	Broad-band	Sound Power Levels (dB) by Octave Band Center Frequency (Hz)								
				32	63	125	250	500	1k	2k	4k	8k
			dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB
Air-core Shunt Reactor Cell[1]	180 MVAR	9 (3 per)	77	-	-	93	-	-	-	-	-	-
Step-up Transformer[1]	180 MVA	3 (1 per)	83	-	-	97	83	80	67	59	52	47
Cooling Fan Bank[1]	Unknown	6 (2 per)	90	-	96	95	92	87	85	79	73	67
HVAC[1]	Unknown	3 (1 per)	88	-	-	-	-	-	-	-	-	-

Notes:

1. Sound levels in some octave bands were not available.

5.5.2 Modeling Methodology

Predicted sound levels resulting from the operation of the proposed onshore substation—assuming all equipment operating simultaneously and at full load—were modeled using Cadna/A noise calculation software (DataKustik Corporation). This software uses the ISO 9613-2 international standard for sound propagation.[16] The benefits of the Cadna/A software are a more refined set of computations due to the inclusion of topography, ground attenuation, multiple building reflections, drop-off with distance, and atmospheric absorption. The Cadna/A software allows for octave band calculation of sound from multiple sources as well as computation of diffraction.

Inputs and significant parameters specified in the model are described below:

- *Site Plan:* A site arrangement drawing, dated December 15, 2022 (see Attachment 2) was used to build the sound model and position electrical components and site structures. Aspects of this site arrangement as included in the sound model are depicted in Figure 5- 5.

- *Modeling Locations:* Sound levels were evaluated at 19 discrete receptor locations, modeled at a height of 1.5 meters (five feet) above ground level to mimic the height of typical adult standing observer's ears. These locations, shown in Figure 5-6, represent the ambient measurement locations (R01-R05), the closest properties with residences in the vicinity of the onshore substation (R06-R16), as well as the residentially zoned properties surrounding the onshore substation ("OnSS") boundary (R17-R19).

- *Terrain Elevation:* Elevation contours for the modeling domain were generated with a resolution of 1 meter from elevation information derived from sub-meter LiDAR data developed by the U.S. Geological Survey as part of the LiDAR for the North East Project and modified for distribution by the National Oceanic and Atmospheric Administration. Site terrain was modeled based on proposed future finished grading provided in the site arrangement drawing.

- *Source Sound Levels:* Broadband and octave band sound power levels for the proposed equipment presented in Tables 5-4 and 5-5 were used as input to the sound model representing simultaneous full load conditions for all equipment.

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[16] *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation,* International Standard ISO 9613-2:1996 (International Organization for Standardization, Geneva, Switzerland, 1996).

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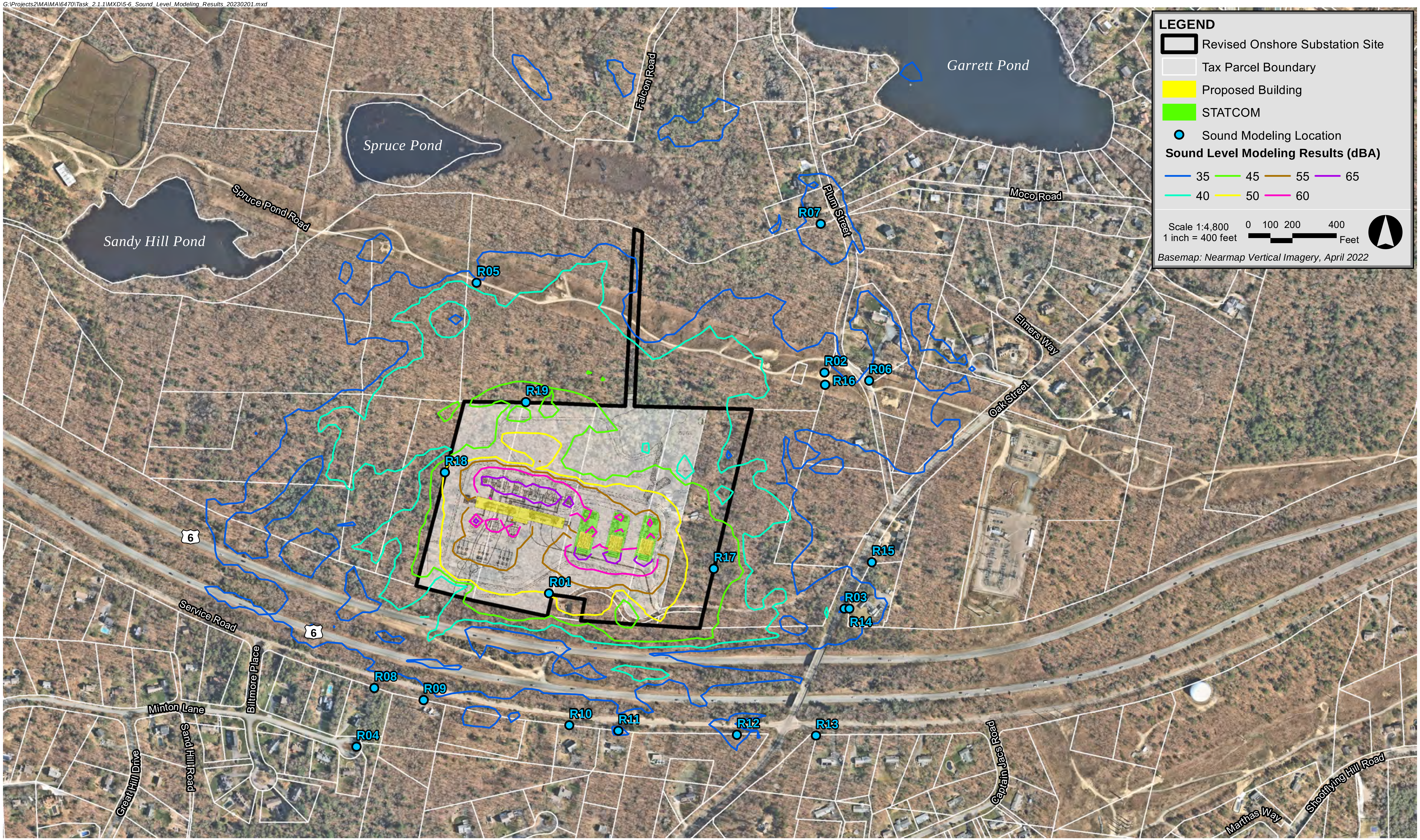

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Figure 5-6

Sound Level Modeling Results

- *Meteorological Conditions:* A temperature of 10°C (50°F) and a relative humidity of 70% was assumed in the model to minimize atmospheric attenuation in the 500 Hz and 1,000 Hz octave bands where the human ear is most sensitive. As per ISO 9613-2, the model assumed favorable conditions for sound propagation, corresponding to a moderate, well-developed ground-based temperature inversion, as might occur on a calm, clear night, or equivalently downwind propagation.
- *Ground Attenuation:* Spectral ground absorption was calculated using a G-factor of 0.5 over land surfaces to represent a moderately reflective surface characterized by a mixture of hard and porous ground, a conservative assumption for much of the year when the ground would be covered in vegetation. The substation site area will be largely finished with crushed stone and was modeled using a G-factor of 0, representing a completely reflective (hard) surface.

5.5.3 Sound Level Modeling Results

Predicted A-weighted and octave band sound level modeling results from the proposed onshore substation layout and equipment at the 19 discrete modeling receptors are presented in Table 5-7. As shown in the table, modeled onshore substation broadband sound levels are expected to range from 24 to 51 dBA between the 19 modeling locations. Predicted sound levels at the neighboring residential property lines ("PL"), R06 through R16, range from 24 to 40 dBA. The values presented in Table 5-7 are "Onshore Substation Only" sound levels and do not include contributions from existing sound sources, e.g., Route 6 vehicular traffic, natural sounds, etc.

In addition to modeling at discrete receptor points, sound levels were also modeled throughout a large grid of points, each spaced 10 meters apart to allow for the generation of sound level isolines. These isolines are presented in Figure 5-6.

Table 5-7 Sound Level Modeling Results – Onshore Substation Only

Modeling Receptor	Type	Broad-band L_{eq}	Sound Pressure Level by Octave Band Center Frequency (Hz)								
			31.5	63	125	250	500	1k	2k	4k	8k
		dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB
R01	Measurement Loc. LT1	50	54	55	56	50	47	45	38	30	17
R02	Measurement Loc. LT2	39	41	44	45	37	37	33	25	10	0
R03	Measurement Loc. ST1	39	47	47	45	38	35	34	26	13	0
R04	Measurement Loc. ST2	28	34	34	37	29	25	17	6	0	0
R05	Measurement Loc. ST3	36	37	39	43[1]	36	35	28	21	8	0
R06	Residential PL	37	39	43	44	36	36	31	23	6	0
R07	Residential PL	36	37	42	41	34	35	30	22	4	0
R08	Residential PL	24	33	33	35	26	21	13	3	0	0
R09	Residential PL	30	37	37	40	31	27	20	9	0	0

Table 5-7 Sound Level Modeling Results – Onshore Substation Only (Continued)

Modeling Receptor	Type	Broad-band L_{eq}	Sound Pressure Level by Octave Band Center Frequency (Hz)								
			31.5	63	125	250	500	1k	2k	4k	8k
		dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB
R10	Residential PL	26	37	36	37	29	23	16	6	0	0
R11	Residential PL	36	40	41	43	38	33	28	18	4	0
R12	Residential PL	36	39	40	43	37	33	29	21	8	0
R13	Residential PL	33	37	38	40	35	31	26	18	2	0
R14	Residential PL	40	47	48	45	38	36	35	27	13	0
R15	Residential PL	34	38	39	42	35	32	28	20	5	0
R16	Residential PL	39	40	44	45	38	37	33	25	10	0
R17	OnSS PL (No Residence)	46	54	54	53	45	42	41	35	26	10
R18	OnSS PL (No Residence)	51	49	55	56	50	50	45	40	32	19
R19	OnSS PL (No Residence)	46	47	52	52	45	45	41	35	27	9

5.6 Evaluation of Sound Levels

Sound level modeling results are evaluated in this section for the operational sounds from the proposed onshore substation. A broadband sound level and ‘pure tone’ evaluation of potential sound level impacts from the onshore substation are provided in the context of the MassDEP Noise Policy. The evaluation is performed using the quiet ambient sound levels described in Section 5.4 and the modeled sound levels from operation of the proposed onshore substation with all equipment operating simultaneously at full load presented in Section 5.5.

The ambient sound levels summarized in Table 5-4 have been assigned to each modeling location. Measurement location LT1 was on the southern edge of the onshore substation site and is representative of modeling locations R01, R08, R09, R10, R11, R12, R13, and R17. Measurement location LT2 was northeast of the onshore substation site near Plum Street and is representative of modeling locations R02, R06, and R16. Measurement location ST1 was east of the onshore substation site on Oak Street and is representative of modeling locations R03, R14, and R15. Measurement location ST2 was south of the onshore substation site and south of Route 6. This location is representative of Modeling Location RO4. Measurement location ST3 was northwest of location is representative of modeling location R04. Measurement location ST3 was northwest of the onshore substation site and is representative of modeling locations R05, R07[17], R18, and R19.

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[17] While R07 is closer in proximity to LT2, this modeling location is farther from Route 6 and Oak Street which primarily drive the ambient sound levels at LT2. Therefore, ST3 was conservatively chosen to represent R07 as it is farther from these roadways.

Table 5-8 presents an evaluation of broadband sound levels at 19 modeling locations, which include residential property lines and other nearby receptors in the vicinity of the proposed revised onshore substation site. Quiet ambient L_{90} sound levels shown in the table were assigned to each modeling location as previously described. Modeled onshore substation broadband L_{eq} sound levels are also provided in the table. The ambient sound levels have been logarithmically added to the modeled sound levels to determine a total broadband sound level for each modeling location. The total sound levels have been compared to the representative, yet conservative, quiet ambient L_{90} sound levels for evaluation. The range of predicted increases over ambient sound levels are outlined in Table 5-8.

The maximum predicted increase over ambient at a property containing a noise-sensitive receptor, e.g., residential, is 7 dBA (at receptors R07, R14, and R16). This increase is predicted only during the quietest hours and with conservative modeling assumptions, as described above (including the simultaneous full-load operation of all substation equipment at the quietest hours and during meteorological conditions favorable for sound propagation). Modeled increases over ambient at all other residential property lines containing a noise-sensitive receptor (at receptors R06, R08 through R13, and R15), during quiet hours are 6 dBA or less. Figure 5-7 shows the modeled increase over ambient at all residential property lines containing a noise-sensitive receptor. As previously noted, ambient sound levels in the general vicinity of the Project onshore substation are substantially higher during the daytime, and during those times, sound level increases will be lower. As described in Section 5.3.2, the MassDEP Noise Policy states, "A new noise source that would be located in an area that is not likely to be developed for residential use in the future (e.g., due to abutting wetlands or similarly undevelopable areas), or in a commercial or industrial area with no sensitive receptors may not be required to mitigate its noise impact on those areas, even if projected to cause noise levels at the facility's property line to exceed ambient background by more than 10 dB(A).." Receptors R17, R18, and R19 are located along the revised onshore substation's eastern, western, and northern property lines, respectively, with modeled increases over ambient greater than 10 dBA. In each of these cases, the adjacent property is residentially zoned; however, the adjacent properties are Article 97-protected land owned by the Town of Barnstable and managed by the Conservation Commission. As such, it is not likely that these parcels could be developed for residential use in the future. Additionally, based on the location of these parcels, access easements from one or more property owners may be required for them to be developed in the future.

Table 5-9 presents total octave band sound levels at each of the 19 modeling receptors. Modeled OnSS-only octave band L_{eq} sound levels shown in the earlier Table 5-7 were logarithmically added to the representative, yet conservative, quiet ambient octave band L_{90} sound levels. A review of the levels in Table 5-9 reveals that no MassDEP-defined pure tones are anticipated from operation of the Project onshore substation at any modeled receptor.

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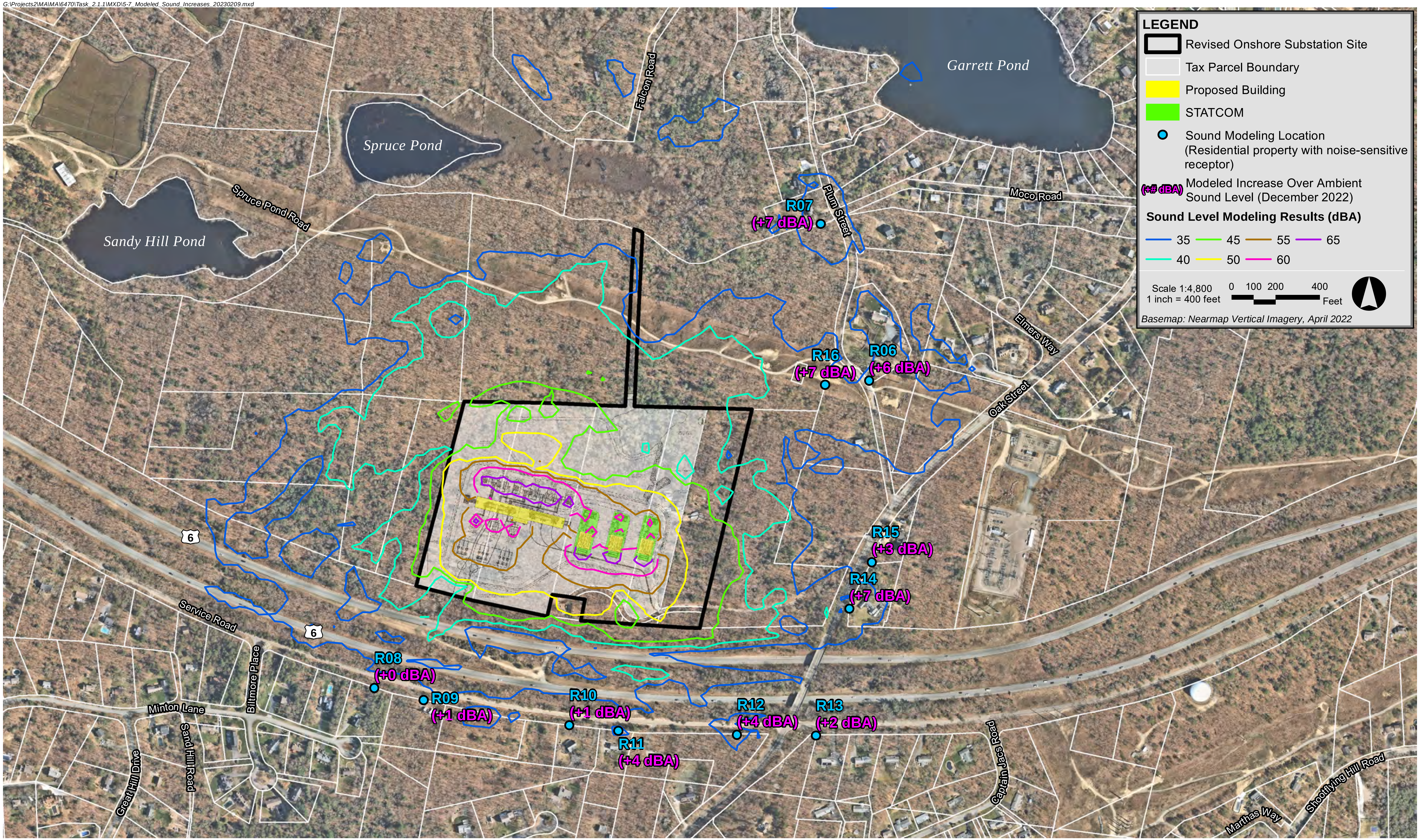

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Figure 5-7

Modeled Increases Over Ambient Sound Levels at Residential Properties

Table 5-8 Evaluation of Broadband Sound Levels

Modeling Location	Type	Rep. Ambient Location	Ambient L_{90} Sound Level (dBA)	Modeled Project OnSS-Only L_{eq} Sound Level (dBA)	Total Sound Level (dBA)[1]	Increase Over Ambient[1]	Meets MassDEP Noise Policy?
R01	Measurement Loc. LT1	LT1	34	50	50	16	n/a[2]
R02	Measurement Loc. LT2	LT2	32	39	39	7	Yes
R03	Measurement Loc. ST1	ST1	34	39	40	6	Yes
R04	Measurement Loc. ST2	ST2	36	28	36	1	Yes
R05	Measurement Loc. ST3	ST3	29	36	37	8	Yes
R06	Residential PL	LT2	32	37	38	6	Yes
R07	Residential PL	ST3	29	36	36	7	Yes
R08	Residential PL	LT1	34	24	35	0	Yes
R09	Residential PL	LT1	34	30	36	1	Yes
R10	Residential PL	LT1	34	26	35	1	Yes
R11	Residential PL	LT1	34	36	38	4	Yes
R12	Residential PL	LT1	34	36	38	4	Yes
R13	Residential PL	LT1	34	33	37	2	Yes
R14	Residential PL	ST1	34	40	41	7	Yes
R15	Residential PL	ST1	34	34	37	3	Yes
R16	Residential PL	LT2	32	39	40	7	Yes
R17	OnSS PL (No Residence)	LT1	34	46	46	12	Yes[3]
R18	OnSS PL (No Residence)	ST3	29	51	51	22	Yes[3]
R19	OnSS PL (No Residence)	ST3	29	46	46	17	Yes[3]

Notes:

1. Sound pressure levels rounded to the nearest whole decibel are shown. Sound level addition was performed with greater precision.
2. Location is within the Project OnSS parcel; therefore, the limit does not apply but the results are presented for informational purposes.
3. Location is on the property line of an adjacent residentially zoned parcel; however, there is no residence (noise sensitive receptor) on the property and the property is Article 97-protected land owned by the Town of Barnstable and managed by the Conservation Commission. As such, it is unlikely that those parcels could be developed for residential purposes, so the 10 dBA increase for residential property under the MassDEP Noise Policy does not apply

Table 5-9 MassDEP Pure Tone Evaluation of Octave Band Sound Levels

Modeling Receptor	Type	Total Sound Pressure Levels[1] by Octave Band Center Frequency (Hz)								
		31.5	63	125	250	500	1k	2k	4k	8k
		dB	dB	dB	dB	dB	dB	dB	dB	dB
R01	Measurement Loc. LT1	55	55	56	50	47	45	39	31	19
R02	Measurement Loc. LT2	45	45	46	39	38	34	25	13	8
R03	Measurement Loc. ST1	48	48	45	38	36	35	28	21	17
R04	Measurement Loc. ST2	43	41	38	32	31	30	27	26	22
R05	Measurement Loc. ST3	40	40	43	36	35	30	23	16	12
R06	Residential PL	44	44	44	38	37	32	23	11	8
R07	Residential PL	40	42	41	34	35	31	23	16	12
R08	Residential PL	41	40	37	32	31	31	24	17	14
R09	Residential PL	42	41	40	34	32	31	24	17	14
R10	Residential PL	42	40	38	33	31	31	24	17	14
R11	Residential PL	43	43	43	39	35	33	25	18	14
R12	Residential PL	43	42	43	38	35	33	26	18	14
R13	Residential PL	42	41	41	36	33	32	25	18	14
R14	Residential PL	48	48	45	39	37	36	29	22	17
R15	Residential PL	42	41	42	36	34	31	25	21	17
R16	Residential PL	45	45	46	39	38	34	25	13	8
R17	OnSS PL (No Residence)	54	54	53	46	42	41	35	26	15
R18	OnSS PL (No Residence)	50	55	56	50	50	45	40	32	19
R19	OnSS PL (No Residence)	47	52	52	45	45	41	35	27	14

Notes:

1. Sound pressure levels rounded to the nearest whole decibel are shown. Sound level addition was performed with greater precision.

In summary, the sound level increases, and total sound levels presented in this section are conservatively based on the average of the daily low background sound levels, typically occurring during late-night hours, which were measured during defoliate, off-peak season, conditions. Conservative assumptions were applied to the modeling as well. During the vast majority of time, background sound levels are expected to be considerably higher than those assumed in this evaluation based on the diurnal vehicular activity on Route 6 that also increases during warmer seasons, and the resulting increase in sound levels over ambient sound levels will be less. Finally, based on modeled sound levels, the onshore substation complies with the MassDEP Noise Policy.

Section 6.0

Onshore Substation Visual Analysis

6.0 ONSHORE SUBSTATION VISUAL ANALYSIS

Saratoga Associates, Landscape Architects, Architects, Engineers, and Planners, P.C. (Saratoga) was retained by the Company to conduct a visibility assessment of the revised onshore substation design. The visibility assessment included a viewshed analysis, photographic simulations, and line-of-sight profiles to identify the degree and character of potential visibility of the proposed onshore substation from off-site vantage points.

As described in Section 2.1 above, surrounding land uses include the DCR fire tower and Route 6 SHLO to the south and Article 97 protected land to the west, north, and east. Existing Eversource ROW #342 and Spruce Pond Road are also located north of the substation site. The local landscape is characterized by a gently rolling glacial moraine outwash topography typical of this portion of Cape Cod. Except for minor areas around the DCR fire tower and existing residential structures (to be removed), the substation site and all adjacent properties to the north, east and west are densely wooded with mature pitch pine and scrub oak vegetation. A 100-foot-wide densely wooded buffer also exists within the Route 6 SHLO along the southern boundary of the substation site. The wider Project area is generally suburban in character comprised of low to moderate density (i.e., 1 to 5+ acre) single-family residential lots and undeveloped woodland open space. Approximately 22 single family residential structures are within 1,000 feet of the Project substation site. Seventeen of these residential structures are in residential neighborhoods to the south of Route 6. Two residential structures (56 Plum Street and 141 Plum Street) are north of the existing Eversource ROW #342, and three residential structures are located along Oak Steet between Route 6 and the existing Eversource ROW #342 (35 Plum Street, 550 Oak Street, and 575 Oak Street).

The Zone of Visual Influence (ZVI) analysis conducted identified the geographic area within which some portions of the proposed revised onshore substation design could potentially be visible. The ZVI extends to a two-mile radius from the proposed onshore substation. The results of the ZVI analysis demonstrate that within 0.5-mile of the proposed onshore substation, views of the substation equipment will be limited and occur in small isolated geographic pockets. These isolated views are primarily found within cleared areas of the existing Eversource ROW #342 and Route 6. Areas with isolated views along Route 6 are generally on the west bound side of Route 6 with one location along the east bound side of Route 6 and these views will likely go unnoticed by motorists travelling at highway speed (Route 6 has a speed limit of 55 mph). Beyond 0.5-mile of the proposed onshore substation, a line-of-sight to lower height electrical structures (30 feet tall) and one or more lightning masts (80 feet tall and approximately 3 feet in diameter at the base tapering to 2 feet in diameter at the top) may occur in distant areas approximately 1.25 miles to north of the substation site. Distant visibility of one or more lightning masts is also found on the southern half of Lake Wequaquet, approximately one mile southeast of the substation site. Affected viewers may include boaters and shoreline residential properties with open water vistas to the northwest. In all cases, visibility of proposed onshore substation components will likely go unnoticed as they will be low within the existing tree line, distant, and away from residential properties and areas commonly visited by the public.

Photographic simulations from six representative key observation points demonstrate that lower height electrical equipment and buildings (30 feet tall) fall well below the intervening tree line from all studied vantage points and are screened or obscured from view. The upper portion of one or more lightning mast (80 feet tall, approximately 2 feet in diameter at the top) may be visible low within the existing tree line from two of the representative key observation points (along Route 6) and from Plum Street within the existing Eversource ROW #342. In both cases, the predicted visibility is minor in nature and is anticipated to go unnoticed by observers.

Finally, line-of-sight (LOS) profiles were completed for the six representative key observation points. The LOS profiles illustrate the potential screening effects of topography, vegetation, and structures from the six representative key observation points. The results of the LOS profiles further reinforce the effectiveness of intervening woodland vegetation to remain in providing visual screening from nearby residential properties and public roadways.

The visibility assessment demonstrates that views of the proposed new onshore substation are limited and represent a de minimis alteration to the existing visual character of the local landscape. Lower height electrical equipment and buildings associated with the proposed revised onshore substation will not be directly visible from any off-site vantage point. In areas where lightning masts are predicted to be visible; the lightning masts will be low within the intervening tree line. Land and tree clearing will be minimized to the extent practicable and an existing forested buffer around the substation will be maintained (see Attachment 2, Drawing Sheet 8, and Analysis Attachment B4, Drawing Sheet 7). See Attachment 9 for a copy of the Visibility Assessment Report including existing condition photographs, zone of visual influence maps, photographic simulations, and line-of-sight profiles.

Section 7.0

Update on Power Purchase Agreements

7.0 UPDATE ON POWER PURCHASE AGREEMENTS

As described in the Section 1.2.2 of the Analysis submitted the Siting Board and Department of Public Utilities ("Department"), on December 17, 2021, the Department of Energy Resources in conjunction with the Massachusetts Electric Distribution Companies (EDCs) selected the Commonwealth Wind Project, which includes the New England Wind 2 Connector, the Project under review in this proceeding, in a third solicitation to procure offshore wind energy generation under Section 83C.[18] The Company executed power purchase agreements (PPAs) in April 2022 with the EDCs (Eversource, National Grid, and Unitil) for approximately 1,200 MW of the Commonwealth Wind Project's output. The EDCs filed the PPAs with the Department for its review in May 2022. The Department docketed the PPA proceedings at D.P.U. 22-70, 22-71, and 22-72.

On October 27, 2022, the Company moved for a one-month suspension of the PPA proceedings. The Company raised the issue that economic conditions had changed significantly due to global commodity price increases (in part due to ongoing war in Ukraine), historic and persistent inflation, sharp increases in interest rates, and supply chain bottlenecks, as well as other factors, resulting in significantly increased costs for the Commonwealth Wind project and rendering the PPAs ineffective at allowing the Proponent to secure financing needed to construct Commonwealth Wind and associated NE Wind 2 Connector

On November 4, 2022, the Department declined to suspend the PPA proceedings. The Company worked diligently to negotiate with the parties to find a solution. However, a resolution was not ultimately reached, and the Company moved to dismiss the PPA proceedings. On December 30, 2022, the Department issued an order denying the Company's motion and approving the PPAs. On January 19, 2023, the Company appealed the Department's order at the Massachusetts Supreme Judicial Court.

Since that time, the Proponent has been in close contact with the EDCs and is seeking a termination of the PPAs. The Proponent intends to bid the full capacity of Commonwealth Wind into the next offshore wind solicitation under Section 83C. That solicitation was released in draft form on May 2, 2023 and filed with the DPU.

The Proponent is confident that the Project is needed now more than ever to deliver clean energy and economic growth to the Commonwealth and the region. The Proponent remains confident that the Commonwealth Wind project will be built, and is proceeding with Project permitting. The Proponent will continue to move the Project forward to ensure that it remains on a development timeline that allows it to meet key state renewable energy targets, including the Commonwealth's 2030 offshore wind and emissions reduction goals. The Commonwealth Wind project and associated NE Wind 2 Connector is a

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[18] *See* Section 83C of Chapter 169 of the Acts of 2008, as amended by Chapter 188 of the Acts of 2016, An Act to Promote Energy Diversity, Chapter 8 of the Acts of 2021, An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy, Chapter 24 of the Acts of 2021, An Act Making Appropriations for the Fiscal Year 2022, and Chapter 179 of the Acts of 2022, An Act Driving Clean Energy and Offshore Wind.

cost-effective source of offshore wind energy generation for Massachusetts and will provide benefits to Massachusetts and its ratepayers. For those reasons, the Proponent remains fully committed to continuing the development of this Project.

Attachment 1

BOEM New England Wind Draft Environmental Impact Statement – Volume I

OCS EIS/EA
BOEM-2022-0070

New England Wind Project Draft Environmental Impact Statement

December 2022

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

BOEM
Bureau of Ocean Energy Management

COVER SHEET

ENVIRONMENTAL IMPACT STATEMENT FOR THE NEW ENGLAND WIND PROJECT

Draft (x)   Final ( )

Type of Action: Administrative (x)   Legislative ( )

Area of Potential Impact: Area of Renewable Energy Lease Area OCS-A 0534

Agency	Contact
U.S. Department of the Interior Bureau of Ocean Energy Management (BOEM) 45600 Woodland Road Sterling, VA 20166	Christine Crumpton (VAM-OREP) U.S. Department of the Interior Bureau of Ocean Energy Management 45600 Woodland Road Sterling, VA 20166 (703) 787-1423

ABSTRACT

This Draft Environmental Impact Statement (EIS) assesses the reasonably foreseeable impacts on physical, biological, socioeconomic, and cultural resources that could result from the construction and installation, operations and maintenance, and conceptual decommissioning of the New England Wind Project (Project) proposed by Park City Wind, LLC (Park City Wind), in its Construction and Operations Plan (COP). The proposed Project described in the COP and this Draft EIS would be at least 2,036 megawatts in scale (and up to 2,600 megawatts) approximately 20 miles from the southwest corner of Martha's Vineyard and approximately 24 miles from Nantucket at its closest point, within the area of Renewable Energy Lease Number OCS-A 0534 (Lease Area). The Project would serve demand for renewable energy in one or more New England states. This Draft EIS was prepared in accordance with the requirements of the National Environmental Policy Act (42 United States Code 4321–4370f) and implementing regulations of the Council on Environmental Quality and the Department of the Interior. This Draft EIS will inform the Bureau of Ocean Energy Management's decision on whether to approve, approve with modifications, or disapprove the Project's COP. Publication of the Draft EIS initiates a 60-day public comment period, after which all the comments received will be assessed and considered by BOEM in preparation of a Final EIS.

Additional copies of this Draft Environmental Impact Statement may be obtained by writing the Bureau of Ocean Energy Management, Attn: Christine Crumpton (address above); by telephone at (703) 787-1423; or by downloading from the BOEM website at https://www.boem.gov/renewable-energy/state-activities/new-england-wind-formerly-vineyard-wind-south.

Executive Summary

ES.1 Introduction

This Draft Environmental Impact Statement (EIS) assesses the reasonably foreseeable impacts on physical, biological, socioeconomic, and cultural resources that could result from the construction and installation (construction), operations and maintenance (operations), and conceptual decommissioning (decommissioning) of a commercial-scale offshore wind energy facility and transmission cable to shore known as the New England Wind Project (Project) proposed by Park City Wind, LLC (Park City Wind, the applicant). The proposed Project consists of two phases: Phase 1, which is also known as the Park City Wind Project, and Phase 2, which is also known as the Commonwealth Wind Project. The proposed Project described in the applicant's Construction and Operations Plan (COP) and this Draft EIS would occupy all of the Bureau of Ocean Energy Management's (BOEM) Renewable Energy Lease Number (Lease Area) OCS-A 0534 and potentially a portion of the area covered by Lease Area OCS-A 0501 (the Southern Wind Development Area [SWDA]).[1]

BOEM has prepared the Draft EIS under the National Environmental Policy Act (NEPA) (U.S. Code, Title 42, Sections 4321–4370f [42 USC §§ 4321–4370f). This Draft EIS will inform BOEM's decision on whether to approve, approve with modifications, or disapprove the proposed Project's COP. Cooperating agencies may rely on this Draft EIS to support their decision-making. In conjunction with submitting its COP, Park City Wind applied to the National Marine Fisheries Service (NMFS) for an Incidental Take Authorization (ITA) under the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 USC § 1361 et seq.), for incidental take of marine mammals during proposed Project construction. NMFS is required to review applications and, if appropriate, issue an ITA under the MMPA. NMFS intends to adopt the Final EIS if, after independent review and analysis, NMFS determines the Final EIS to be sufficient to support the authorization. The U.S. Army Corps of Engineers (USACE) similarly intends to adopt the Final EIS to meet its responsibilities under Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act of 1899 (RHA).

ES.2 Purpose of and Need for the Proposed Action

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

Through a competitive leasing process under the Code of Federal Regulations, Title 30, Section 585.211 (30 CFR § 585.211), BOEM awarded Lease Area OCS-A 0501 to Vineyard Wind 1, LLC. On June 28, 2021, BOEM assigned 65,296 acres of the area covered by Lease Area OCS-A 0501 to Vineyard Wind 1, LLC. The remaining 101,590 acres were designated as Lease Area OCS-A 0534 (Lease Area), which was assigned to the applicant (Figure ES-1).

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[1] The developer of the Vineyard Wind 1 Project (Vineyard Wind 1, LLC) would assign spare or extra positions in the southwestern portion of OCS-A 0501 to Park City Wind for the New England Wind Project if those positions are not developed as part of the Vineyard Wind 1 Project.

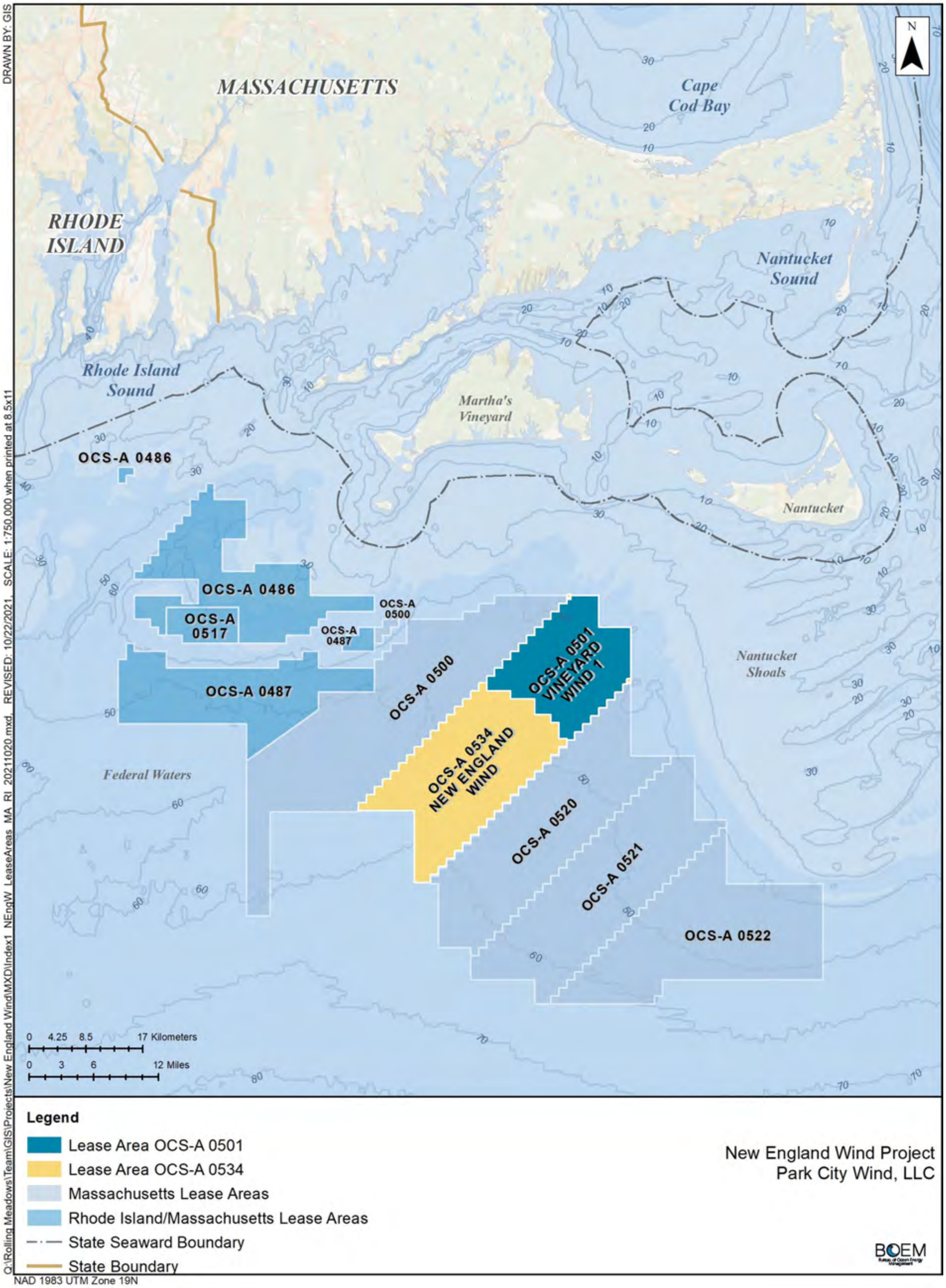


Figure ES-1: Proposed Wind Development Area Relative to Rhode Island and Massachusetts Lease Areas

The applicant has the exclusive right to submit a COP for activities within area covered by Lease OCS-A 0534. A small portion of the area covered by Lease Area OCS-A 0501 not used for development of the Vineyard Wind 1 Project (Vineyard Wind 1) may also be assigned to the applicant and developed as part of the proposed Project (i.e., the New England Wind Project). Under the terms of the lease, the applicant has the exclusive right to submit a COP for activities within the Lease Area, and it has submitted a COP to BOEM proposing the construction, operations, and decommissioning of an offshore wind energy facility in the Lease Area in accordance with BOEM's COP regulations under 30 CFR § 585.626, et seq. (Figures ES-2 through ES-7).

Based on BOEM's authority under the Outer Continental Shelf Lands Act (OCSLA) to authorize renewable energy activities on the Outer Continental Shelf (OCS) and Executive Order 14008 (shared goals of the federal agencies to deploy 30 gigawatts [GW] of offshore wind energy capacity in the United States by 2030 while protecting biodiversity and promoting ocean co-use [The White House 2021]) and in consideration of the goals of the applicant, the purpose of BOEM's action is to determine whether to approve, approve with modifications, or disapprove the COP. BOEM will make this determination after weighing the factors in Subsection 8(p)(4) of the OCSLA that are applicable to plan decisions and in consideration of the above goals. BOEM's action is needed to fulfill its duties under the lease, which require BOEM to make a decision on the lessee's plans to construct and operate a commercial-scale offshore wind energy facility within the Lease Area (the Proposed Action).

In addition, NMFS anticipates receipt of one or more requests for authorization to take marine mammals incidental to activities related to the proposed Project under the MMPA. NMFS' issuance of an MMPA ITA is a major federal action, and, in relation to BOEM's action, is considered a connected action (40 CFR § 1501.9(e)(1)). The purpose of the NMFS action is to evaluate the applicant's request pursuant to specific requirements of the MMPA and its implementing regulations administered by NMFS, consider impacts of the applicant's activities on relevant resources, and, if appropriate, issue the permit or authorization. NMFS needs to render a decision regarding the request for authorization due to NMFS's responsibilities under the MMPA (16 USC § 1371(a)(5)(D)) and its implementing regulations. If NMFS makes the findings necessary to issue the requested authorization, NMFS intends to adopt the Final EIS to support that decision and fulfill its NEPA requirements.

The USACE New England District anticipates requests for authorization of a permit action to be undertaken through authority delegated to the District Engineer by 33 CFR § 325.8, pursuant to Section 10 of the RHA (33 USC § 403) and Section 404 of the CWA (33 USC § 1344). USACE considers issuance of permits under these two delegated authorities a major federal action connected to BOEM's action (40 CFR § 1501.9(e)(1)). The need for the proposed Project as provided by the applicant in the COP and reviewed by USACE for NEPA purposes is to provide a commercially viable offshore wind energy project within the Lease Area. The basic proposed Project purpose, as determined by USACE for Section 404(b)(1) guidelines evaluation, is offshore wind energy generation. The overall proposed Project purpose for Section 404(b)(1) guidelines evaluation, as determined by USACE, is the construction and operations of a commercial-scale offshore wind energy project for renewable energy generation and distribution to the New England energy grids.

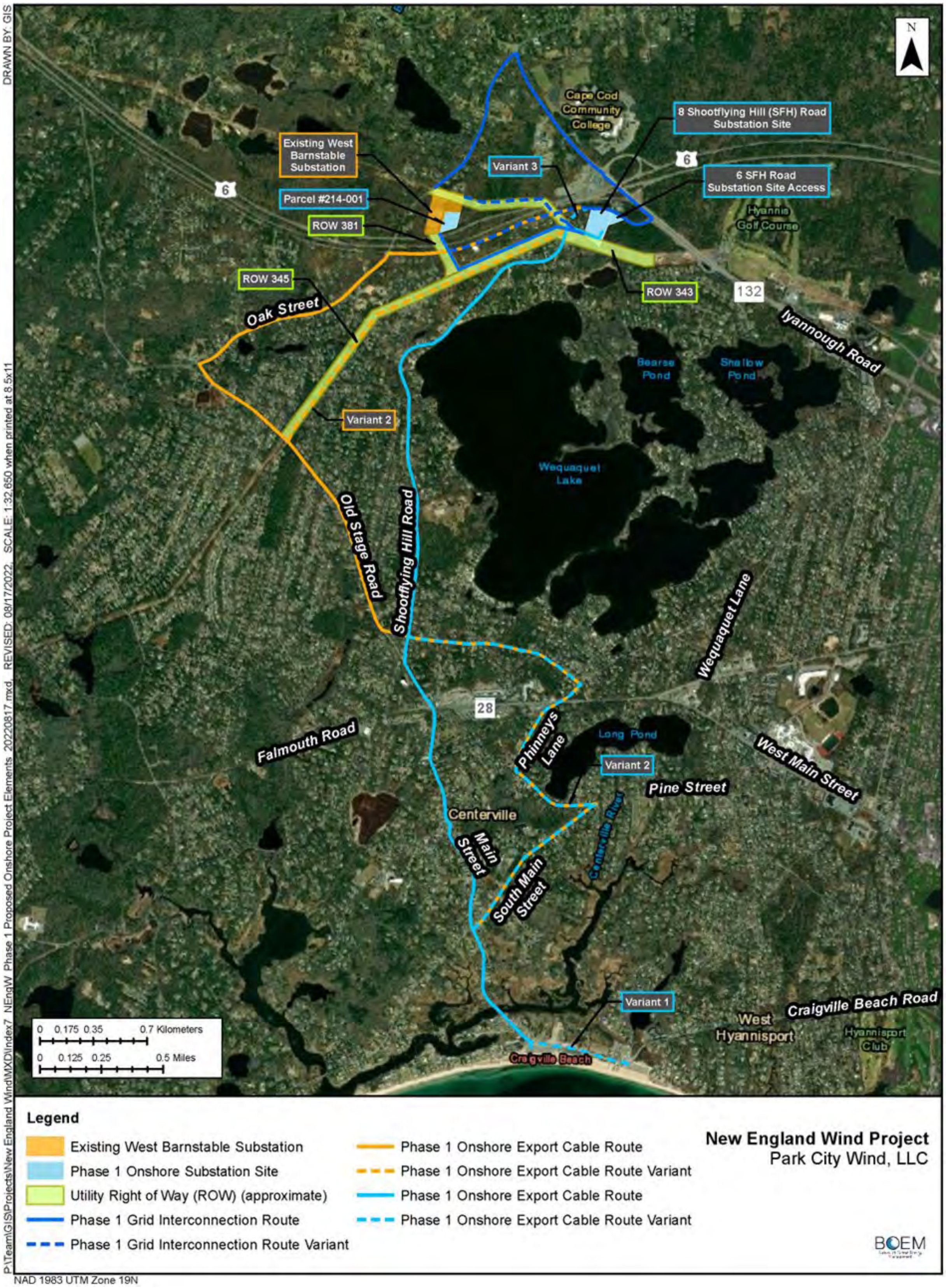
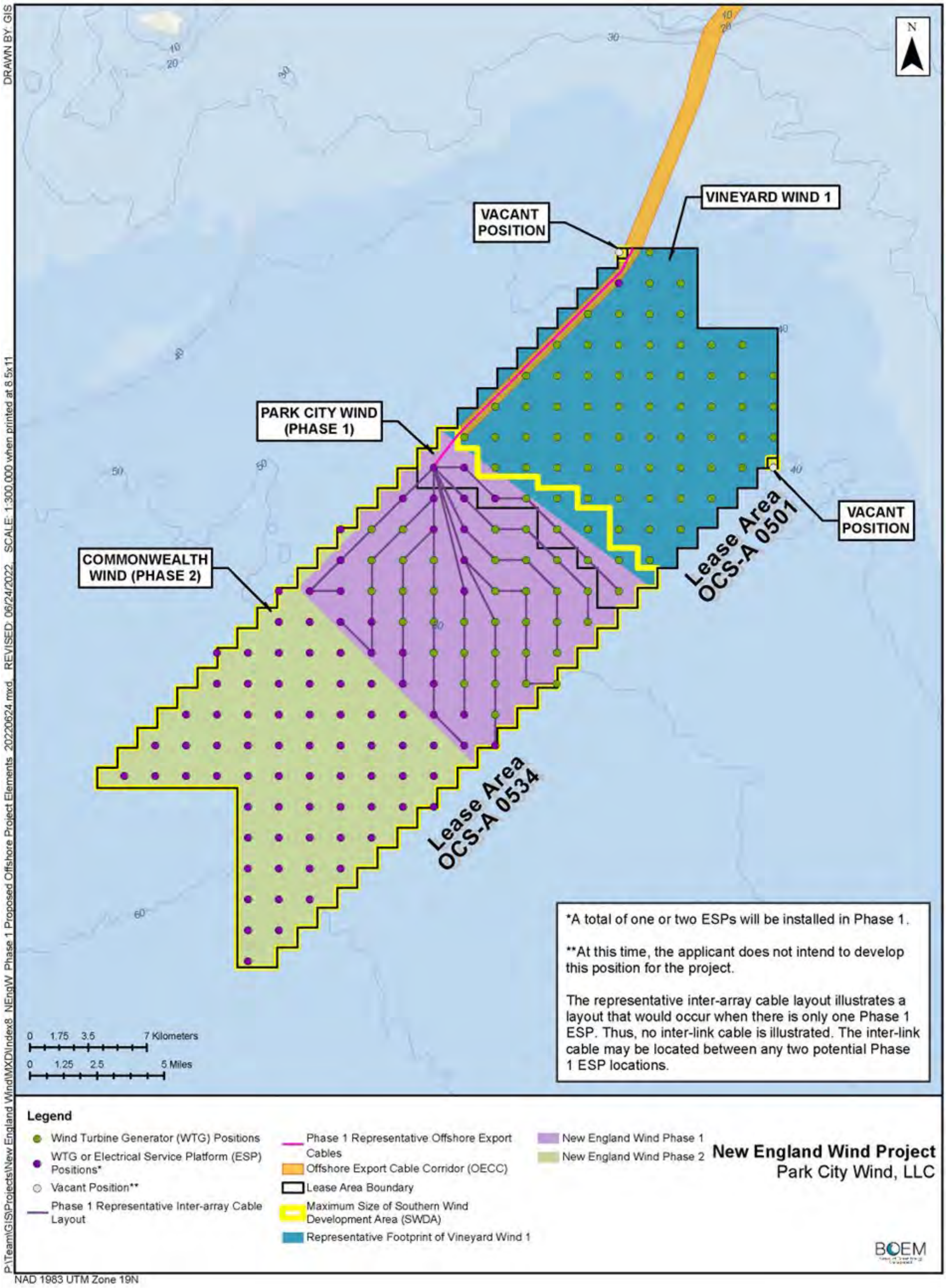


Figure ES-2: Proposed Project Phase 1 Onshore Project Facilities



*A total of one or two ESPs will be installed in Phase 1.

**At this time, the applicant does not intend to develop this position for the project.

The representative inter-array cable layout illustrates a layout that would occur when there is only one Phase 1 ESP. Thus, no inter-link cable is illustrated. The inter-link cable may be located between any two potential Phase 1 ESP locations.

Figure ES-3: Proposed Project Phase 1 Offshore Project Facilities

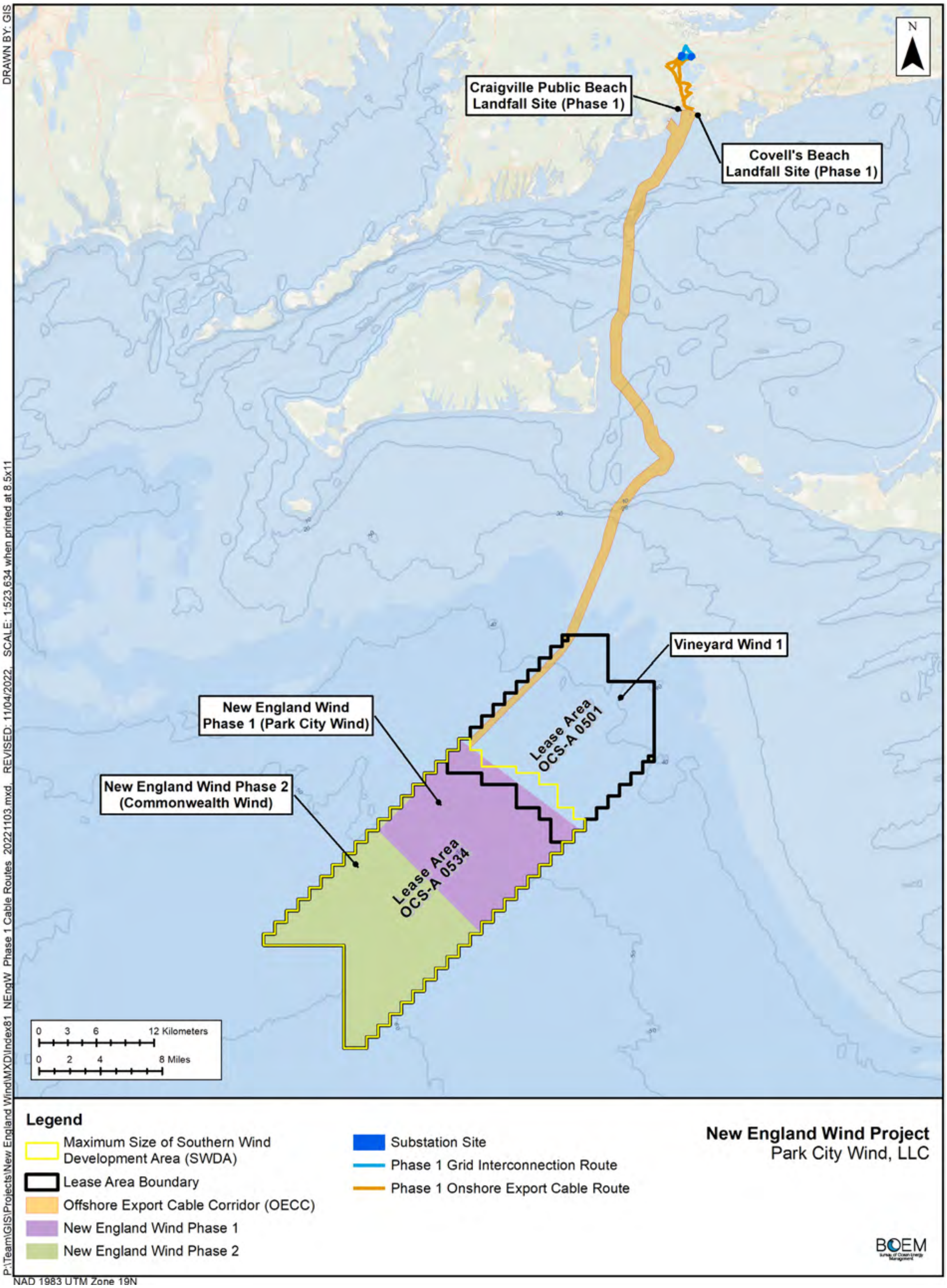
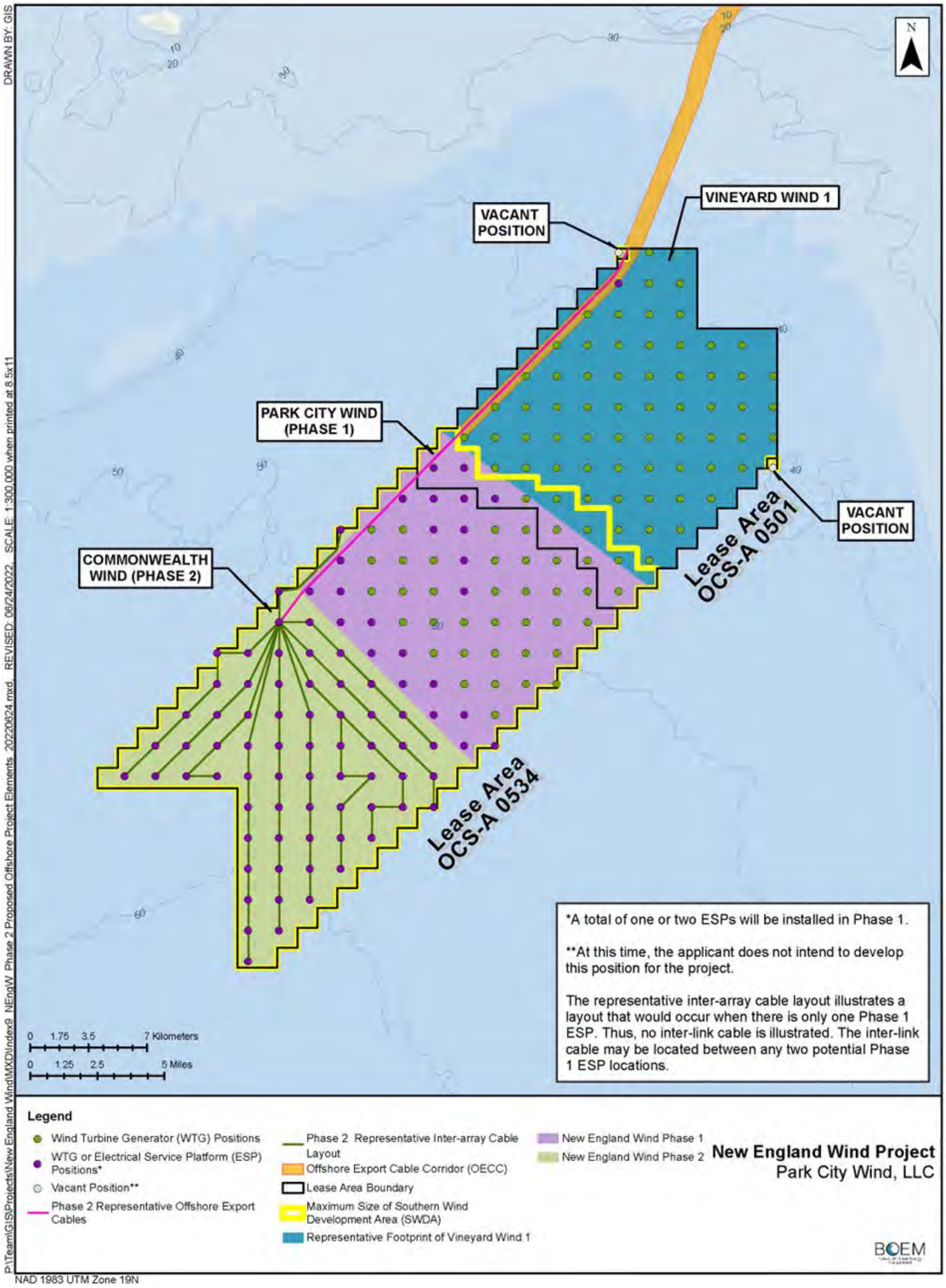


Figure ES-4: Proposed Project Phase 1 Offshore Export Cable Route

ROW = right-of-way

Figure ES-5: Proposed Project Phase 2 Onshore Project Facilities



*A total of one or two ESPs will be installed in Phase 1.

**At this time, the applicant does not intend to develop this position for the project.

The representative inter-array cable layout illustrates a layout that would occur when there is only one Phase 1 ESP. Thus, no inter-link cable is illustrated. The inter-link cable may be located between any two potential Phase 1 ESP locations.

Figure ES-6: Proposed Project Phase 2 Offshore Project Facilities

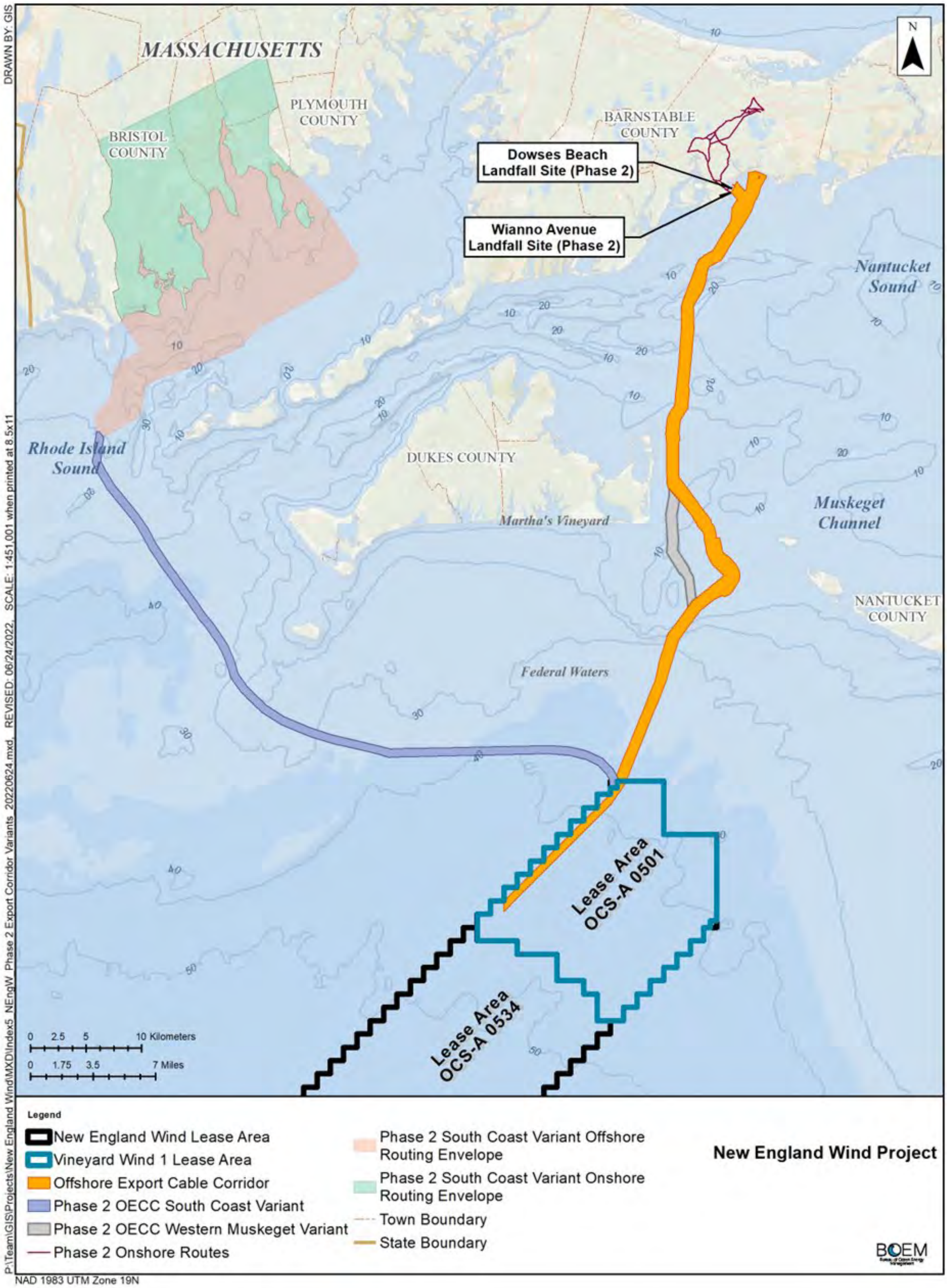


Figure ES-7: Proposed Project Phase 2 Offshore Export Cable Routes

USACE intends to adopt BOEM's EIS to support its decision on any permits and permissions requested under Section 10 of the RHA and Section 404 of the CWA. USACE would adopt the EIS under 40 CFR § 1506.3 if, after its independent review of the document, it concludes that the EIS satisfies USACE's comments and recommendations. Based on its participation as a cooperating agency and its consideration of the Final EIS, USACE would issue a Record of Decision (ROD) to formally document its decision on the Proposed Action.

ES.3 Public Involvement

On June 30, 2021, BOEM issued a Notice of Intent to prepare an EIS, initiating a 30-day public scoping period from March 30 to April 29, 2021 (86 *Federal Register* [Fed. Reg.] 123 p. 34782 [June 30, 2021]). The Notice of Intent solicited public input on the significant resources and issues, impact-producing factors (IPF), reasonable alternatives, and potential mitigation measures to analyze in the EIS. BOEM also used the NEPA scoping process to initiate the Section 106 consultation process under the National Historic Preservation Act (NHPA; 54 USC § 300101 et seq.), as permitted by 36 CFR § 800.2(d)(3), and sought public comment and input through the Notice of Intent regarding the identification of historic properties or potential impacts on historic properties from activities associated with approval of the COP. BOEM held three virtual public scoping meetings on July 19, July 23, and July 26, 2021, to present information on the proposed Project and NEPA process, answer questions from meeting attendees, and solicit public comments. Scoping comments were received through Regulations.gov on docket number BOEM-2021-0047, via email to a BOEM representative, and through oral testimony at each of the three public scoping meetings.

On August 19, 2021, Park City Wind (then operating as Vineyard Wind, LLC) notified BOEM of the potential need to establish offshore export cable corridors (OECC) for Phase 2 of the proposed Project, beyond those previously identified in the COP. Park City Wind also notified BOEM of a change in the Project's name, from the Vineyard Wind South Project to the New England Wind Project. On November 22, 2021, BOEM issued a Notice of Additional Public Scoping and Name Change to announce the proposed Project name change and assess the potential impacts of the Phase 2 OECC alternative routes (86 Fed. Reg. 222 [November 22, 2021] p. 66334). This notice commenced a second public scoping process, between November 22 and December 22, 2021, that was similar in intent and purpose to the first scoping process, focusing on the newly proposed Phase 2 OECC alternative routes. Information, including a video presentation, was posted to BOEM's website to provide supporting information on the Phase 2 OECC alternatives.

BOEM received total of 1,160 comment submissions from federal and state agencies, local governments, non-governmental organizations, and the general public during the two scoping periods. The topics most referenced in the scoping comments included birds; marine mammals; NEPA process and public engagement; socioeconomics; planned activities; commercial fisheries and for-hire recreational fishing; purpose and need; finfish, invertebrates, and essential fish habitat (EFH); mitigation; bats; benthic habitat; regulatory framework; alternatives; sea turtles; reference recommendations; impact methodology and definitions; environmental justice; air quality; Proposed Action; decommissioning; and cultural, historical, and archeological resources. Publication of this Draft EIS initiates a 60-day public comment period. BOEM will consider the comments received on the Draft EIS during preparation of the Final EIS.

ES.4 Alternatives

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

- Alternative A, No Action Alternative
- Alternative B, Proposed Action
- Alternative C, Habitat Impact Minimization Alternative
  - Alternative C-1, Western Muskeget Variant Avoidance
  - Alternative C-2, Eastern Muskeget Route Minimization

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

ES.4.1 Alternative A – No Action

Under the No Action Alternative, BOEM would not approve the COP; the proposed Project construction, operations, and decommissioning would not occur; and no additional permits or authorizations for the proposed Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the proposed Project as described under the Proposed Action would not occur. However, all other past and ongoing impact-producing activities would continue. Under the No Action Alternative, impacts on marine mammals incidental to construction activities would not occur. Therefore, NMFS would not issue the requested authorization under the MMPA. The current resource condition, trends, and impacts from ongoing activities under the No Action Alternative serve as existing conditions against which the direct and indirect impacts of all action alternatives are evaluated.

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

ES.4.2 Alternative B – Proposed Action

The Proposed Action would construct, operate, and decommission a wind energy facility within the range of design parameters described in Volume I of the COP (Epsilon 2022) and summarized in Table ES-1 and Appendix C, Project Design Envelope and Maximum-Case Scenario. Refer to Volume I of the COP (Epsilon 2022) for additional details on proposed Project design.

If technical, logistical, grid interconnection, or other unforeseen issues prevent all Phase 2 export cables from interconnecting at the West Barnstable Substation, the applicant would develop and use the South Coast Variant (SCV) in place of or in addition to the currently proposed Phase 2 OECC and onshore export cable route (OECR) (Figure ES-6). Because the SCV is a contingency, the applicant has not provided information on grid interconnection routes, onshore cable routes, landfall locations, and nearshore cable routes necessary to prepare a sufficient analysis of the SCV at the time of publication of this Draft EIS. Therefore, the analysis of the SCV in this Draft EIS includes available information but reflects some uncertainty. If the applicant determines that the SCV is necessary, the applicant would be required to file a COP revision per 30 CFR § 585.634, describing the need for the SCV and providing the information necessary to complete a sufficient analysis. Table ES-2 summarizes scenarios for Phase 2 export cable installation.

Table ES-1: Summary of Project Design Envelope Parameters

Project Parameter	Details
Layout, size, and capacity	Phase 1: • Up to 62 WTGs • One or two ESPs • 37,066 to 57,081 acres in the SWDA • 804 MW Phase 2: • Up to 88 WTGs • One to three ESPs • 54,857 to 74,873 acres in the SWDA • 1,232 to 1,725 MW Overall: • Up to 130 WTGs • Two to five ESPs • 101,590 to 111,939 acres in the SWDA • 2,036 to 2,600MW • All WTG and ESP positions arranged in a grid with 1 nautical mile (1.9 kilometers, 1.15 miles) between positions in the north-to-south and east-to-west directions[a]
Schedule	• Phase 1 anticipated to be in service as early as 2025 • Phase 2 anticipated to be in service as early as 2027
Foundations (WTGs and ESPs)	Phase 1: • All foundations could be either monopile foundations (with or without a transition piece) or piled jacket foundations with 3 to 4 legs Phase 2: • All foundations could be either monopile (with transition piece, or one-piece monopile/transition piece), jacket (3 to 4 legs) or bottom-frame foundations • Jacket or bottom-frame foundations could have piles or suction bucket bases Overall: • Foundation piles would be installed using a pile-driving hammer • Scour protection would be placed around all foundations
WTGs	Both phases: • Rotor diameter up to 937 feet • Hub height up to 702 feet above MLLW • Top of nacelle height up to 725 feet above MLLW • Maximum vertical blade tip extension up to 1,171 feet above MLLW • Minimum blade tip clearance 89 feet above MLLW • All WTGs painted off white or light grey (no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey) • Nighttime lighting that complies with FAA and USCG lighting standards and consistent with BOEM best practices (BOEM 2021): o USCG-required navigation warning lights mounted on each WTG foundation (no higher than 148 feet above MLLW), visible to at least 5 nautical miles (5.8 miles) during low visibility conditions o Red, flashing FAA aviation hazard lighting on the top of each WTG nacelle and at intervals on each WTG tower o All FAA aviation hazard lights would use an ADLS that would automatically activate lights only when aircraft approach, estimated to be approximately 13 minutes per year (COP Appendix III-K; Epsilon 2022)
Inter-array cables (cables connecting WTGs to ESPs)	• Target burial depth: 5 to 8 feet • Voltage: 132 kV AC • Maximum total cable length: o Phase 1: 139 miles o Phase 2: 201 miles

Project Parameter	Details
ESPs	• Total structure height up to 230 feet above MLLW • Maximum topside dimensions: 238 feet × 197 feet × 125 feet • Nighttime lighting (USCG navigation lighting and FAA aviation hazard lighting) similar to WTGs, including use of ADLS
Inter-link cables (cables connecting ESPs to each other)	• Maximum 275 kV (Phase 1) or 345 kV (Phase 2) AC • Target burial depth of 5 to 8 feet • Maximum total cable length: 11 nautical miles (12.7 miles) (Phase 1) and 32 nautical miles (36.8 miles) (Phase 2) o Phase 1: 12.7 miles o Phase 2: 36.8 miles
Offshore export cables	• Phase 1: o Two cables with maximum 275 kV AC o Maximum cable length (all cables combined) of 125 miles • Phase 2: o Three cables with maximum 345 kV AC o Maximum cable length (all cables combined) of 226 miles • Target burial depth of 5 to 8 feet • Two OECCs variants for Phase 2 (Figure ES-7): o Western Muskeget Variant o SCV
Landfall for the offshore export cable	• Phase 1: Craigville Public Beach (preferred) or Covell's Beach (Figure ES-4) • Phase 2: Dowses Beach (preferred) or Wianno Avenue (Figure ES-7) • All landfalls installed using HDD; no surface disturbance
Onshore export cables	• Separate Phase 1 (Figure ES-2) and Phase 2 (Figure ES-5) OECRs with variants • Onshore cables would generally be installed within public roadway layouts or existing utility easements • Total onshore export cable length o Phase 1: up to 6.5 miles o Phase 2: up to 10.6 miles
Onshore substation and grid interconnection cable	• New 6.7-acre substation at 6 Shootflying Hill Road • Potential use of 2.8-acre parcel adjacent to existing West Barnstable Substation • Grid interconnection cable to existing substation: o Up to 1.8 miles long o Generally installed within public road layouts or entirely within existing utility ROWs • Additional equipment installed at existing West Barnstable Substation

AC = alternating current; ADLS = aircraft detection lighting system; BOEM = Bureau of Ocean Energy Management; COP = Construction and Operations Plan; ESP = electrical service platform; FAA = Federal Aviation Administration; HDD = horizontal directional drilling; kV = kilovolt; MLLW = mean lower low water; MW = megawatts; OECC = offshore export cable corridor; OECR = onshore export cable route; ROW = right-of-way; SCV = South Coast Variant; SWDA = Southern Wind Development Area; USCG = U.S. Coast Guard; WTG = wind turbine generator

[a] The COP seafloor disturbance tables (Appendix III-T; Epsilon 2022), acoustic impacts (Appendix III-M; Epsilon 2022), the Navigation Safety Risk Assessment (COP Appendix III-I; Epsilon 2022), Marine Archaeological Resources Assessment (COP Appendix II-D; Epsilon 2022), and air emissions (COP Appendix III-B; Epsilon 2022) incorporate 132 foundations in 130 WTG/ESP positions (Maria Hartnett, Pers. Comm, November 15, 2022). BOEM is reviewing the "co-located foundation" concept to determine whether it is consistent with the uniform, orthogonal, 1- × 1-nautical-mile (1.15-mile) grid that the applicant and all other developers and applicants for projects in the RI/MA Lease Areas agreed to implement, based on USCG's May 2020 Final Massachusetts and Rhode Island Port Access Route Study (USCG 2020). The Final EIS will include BOEM's determination regarding this issue.

Table ES-2: Offshore Export Cable Corridor Scenarios

Phase 2 OECC Routes	Number of Phase 2 Cables by Scenario					
	1	2	3	4	5[a]	6[a]
Eastern Muskeget OECC	3	2	2	1	1	0
Western Muskeget Variant OECC	0	1	0	2	0	0
SCV OECC[b]	0	0	1	0	2	3

Source: COP Volume I, Table 4.1-2; Epsilon 2022

OECC = offshore export cable corridor; SCV = South Coast Variant

[a] The applicant states that Scenarios 5 and 6 are theoretically possible but unlikely and would require significant delays to Phase 2 due to the need to upgrade substations connected to ISO-NE that are not currently planned for upgrade (Avangrid 2022a).

ES.4.3 Alternative C – Habitat Impact Minimization Alternative

Under Alternative C, construction, operations, and decommissioning of the proposed Project’s wind turbine generators (WTG) and electrical service platforms (ESP) would occur within the range of design parameters outlined in the COP, subject to applicable mitigation and monitoring measures (Appendix H, Mitigation and Monitoring). Compared to Alternative B, this alternative would minimize impacts on complex fisheries habitats—areas of seafloor that are stable, exhibit vertical relief, and/or provide rare habitat compared to the broad sand flats that characterize much of the OCS. Complex habitats include gravel or pebble-cobble beds, sand waves, biogenic structures (e.g., burrows, depressions, sessile soft-bodied invertebrates), shell aggregates, boulders, hard-bottom patches, and cobble beds, among other features (COP Volume II-A, Section 5.2; Epsilon 2022). To minimize impacts on complex fisheries habitats, BOEM would limit the potential OECC construction scenarios described in Table ES-3 through the implementation of one of the sub-alternatives described below:

- Alternative C-1, Western Muskeget Variant Avoidance: This alternative would preclude the use of the Western Muskeget Variant, limiting available scenarios to those that include only the Eastern Muskeget route and SCV, as shown on Figure ES-7. Scenarios 1, 3, and 5 in Table 2.1-2 would be considered under Alternative C-1. Avoiding use of the Western Muskeget Variant would avoid a crossing of a proposed OECC route for the Mayflower Wind Energy Project (Mayflower Wind) (Lease Area OCS-A 0521) within the Western Muskeget Channel.
- Alternative C-2, Eastern Muskeget Route Minimization: This alternative would minimize, to the degree practicable, the use of the Eastern Muskeget route and maximize the use of the Western Muskeget Variant and/or the SCV (Scenarios 5 and 6 in Table 2.1-2) for all Phase 2 export cables. Under this alternative, the two Phase 1 cables would be installed in the Eastern Muskeget route, along with a maximum of one Phase 2 cable. This eliminates the option for a total of two to three Phase 2 cables to be installed in the Eastern Muskeget route.

ES.5 Environmental Impacts

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

This Draft EIS assesses past, present (ongoing), and reasonably foreseeable future (planned) activities that could occur during the life of the proposed Project. Appendix E describes the past and ongoing actions that BOEM has identified as potentially contributing to existing conditions and the planned activities potentially contributing to cumulative impacts when combined with impacts from the alternatives over the specified spatial and temporal scales.

Each resource-specific section in Chapter 3 of this Draft EIS includes a description of existing conditions of the affected environment. That baseline considers past and present activities in the geographic analysis area, including those related to offshore wind projects with an approved COP (e.g., the Vineyard Wind 1 Project in Lease Area OCS-A 0501 and the South Fork Wind Project in Lease Area OCS-A 0517) and approved past and ongoing site assessment surveys, as well as other non-wind activities (e.g., Navy military training, existing vessel traffic, climate change). The existing condition of resources, as influenced by past and ongoing activities and trends, comprises the baseline condition for impact analysis. Other factors currently affecting the resource, including climate change, are also acknowledged for that resource and are included in the impact-level conclusion.

Chapter 3 analyzes potential impacts on resources that could result from the proposed Project and alternatives to the Proposed Action. The potential impacts resulting from the Proposed Action are compared to the No Action Alternative, and potential impacts resulting from the alternatives are compared to the Proposed Action and each other. Cumulative impacts are analyzed and concluded separately in each resource-specific section in Chapter 3 of this Draft EIS.

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

Table ES-3: Summary and Comparison of Impacts Among Alternatives

Resources	**Alternative B[a, b]**	**Alternative C[a, b]**
Benthic Resources: *Project Impacts*	**Negligible** to **Moderate**	**Negligible** to **Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Benthic Resources: *Planned Activities without Project Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Benthic Resources: *Cumulative Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Coastal Habitats and Fauna: *Project Impacts*	**Minor** to **Moderate**	**Minor** to **Moderate**
	Minor Beneficial	**Minor Beneficial**
Coastal Habitats and Fauna: *Planned Activities without Project Impacts*	**Moderate**	**Moderate**
	Minor Beneficial	**Minor Beneficial**
Coastal Habitats and Fauna: *Cumulative Impacts*	**Minor** to **Moderate**	**Minor** to **Moderate**
	Minor Beneficial	**Minor Beneficial**
Finfish, Invertebrates, and Essential Fish Habitat: *Project Impacts*	**Negligible to Moderate**	**Negligible to Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Finfish, Invertebrates, and Essential Fish Habitat: *Planned Activities without Project Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Finfish, Invertebrates, and Essential Fish Habitat: *Cumulative Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Marine Mammals: *Project Impacts*	**Negligible to Moderate**	**Negligible to Moderate**
	Minor Beneficial	**Minor Beneficial**
Marine Mammals: *Planned Activities without Project Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Marine Mammals: *Cumulative Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Sea Turtles: *Project Impacts*	**Negligible to Moderate**	**Negligible to Moderate**
	Minor Beneficial	**Minor Beneficial**
Sea Turtles: *Planned Activities without Project Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Sea Turtles: *Cumulative Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Commercial Fisheries and For-Hire Recreational Fishing: *Project Impacts*	**Negligible to Moderate**	**Negligible to Moderate**
	Minor Beneficial	**Minor Beneficial**
Commercial Fisheries and For-Hire Recreational Fishing: *Planned Activities without Project Impacts*	**Moderate to Major**	**Moderate to Major**
	Minor Beneficial	**Minor Beneficial**
Commercial Fisheries and For-Hire Recreational Fishing: *Cumulative Impacts*	**Major**	**Major**
	Minor Beneficial	**Minor Beneficial**
Cultural Resources: *Project Impacts*	**Moderate**	**Moderate**

Resources	**Alternative B[a, b]**	**Alternative C[a, b]**
Cultural Resources: *Planned Activities without Project Impacts*	**Minor to Major**	**Moderate**
Cultural Resources: *Cumulative Impacts*	**Minor to Major**	**Minor to Major**
Demographics, Employment, and Economics: *Project Impacts*	**Minor**	**Minor**
	Minor Beneficial	**Minor Beneficial**
Demographics, Employment, and Economics: *Planned Activities without Project Impacts*	**Minor**	**Minor**
	Moderate Beneficial	**Moderate Beneficial**
Demographics, Employment, and Economics: *Cumulative Impacts*	**Minor**	**Minor**
	Moderate Beneficial	**Moderate Beneficial**
Environmental Justice: *Project Impacts*	**Minor**	**Minor**
	Minor Beneficial	**Minor Beneficial**
Environmental Justice: *Planned Activities without Project Impacts*	**Minor**	**Minor**
	Minor Beneficial	**Minor Beneficial**
Environmental Justice: *Cumulative Impacts*	**Minor**	**Minor**
	Minor Beneficial	**Minor Beneficial**
Navigation and Vessel Traffic: *Project Impacts*	**Negligible to Moderate**	**Negligible to Moderate**
Navigation and Vessel Traffic: *Planned Activities without Project Impacts*	**Moderate**	**Moderate**
Navigation and Vessel Traffic: *Cumulative Impacts*	**Negligible to Moderate**	**Negligible to Moderate**
Other Uses: *Project Impacts*	**Minor** to **Moderate** for National security and military; **Minor** for aviation and air traffic; **Negligible** for offshore cables and pipelines and marine minerals; **Minor** to **Moderate** for radar systems; and **Major** for scientific research and surveys	**Minor** to **Moderate** for national security and military; **Minor** for aviation and air traffic; **Negligible** for offshore cables and pipelines and marine minerals; **Moderate** for radar systems; and **Major** for scientific research and surveys
Other Uses: *Planned Activities without Project Impacts*	**Negligible** for marine minerals; **Negligible to Minor** for aviation and air traffic and offshore cables and pipelines; **Minor** for national security and military; **Moderate** for radar systems; and **Major** for scientific research and surveys and USCG SAR activities	**Negligible** for marine minerals**; Negligible to Minor** for aviation and air traffic and offshore cables and pipelines; **Minor** for national security and military; **Moderate** for radar systems; and **Major** for scientific research and surveys and USCG SAR activities
Other Uses: *Cumulative Impacts*	**Minor** to **Major** for national security and military; **Minor** for aviation and air traffic; **Negligible** for offshore cables and pipelines and marine minerals; **Moderate** for radar systems; and **Major** for scientific research and surveys	**Minor** to **Major** for national security and military; **Minor** for aviation and air traffic; **Negligible** for offshore cables and pipelines and marine minerals; **Moderate** for radar systems; and **Major** for scientific research and surveys
Recreation and Tourism: *Project Impacts*	**Minor**	**Minor**
	Minor Beneficial	**Minor Beneficial**
Recreation and Tourism: *Planned Activities without Project Impacts*	**Moderate**	**Moderate**
	Minor Beneficial	**Minor Beneficial**

Resources	**Alternative B[a, b]**	**Alternative C[a, b]**
Recreation and Tourism: *Cumulative Impacts*	**Moderate**	**Moderate**
	Minor Beneficial	**Minor Beneficial**
Scenic and Visual Resources: *Project Impacts*	**Minor**	**Minor**
Scenic and Visual Resources: *Planned Activities without Project Impacts*	**Minor** to **Major**	**Minor** to **Major**
Scenic and Visual Resources: *Cumulative Impacts*	**Moderate to Major**	**Moderate to Major**
Air Quality: *Project Impacts*	**Minor**	**Minor**
	Moderate Beneficial	**Moderate Beneficial**
Air Quality: *Planned Activities without Project Impacts*	**Minor**	**Minor**
	Minor to **Moderate Beneficial**	**Minor** to **Moderate Beneficial**
Air Quality: *Cumulative Impacts*	**Minor**	**Minor**
	Moderate Beneficial	**Moderate Beneficial**
Water Quality: *Project Impacts*	**Minor**	**Minor**
Water Quality: *Planned Activities without Project Impacts*	**Minor** to **Moderate**	**Minor** to **Moderate**
Water Quality: *Cumulative Impacts*	**Minor to Moderate**	**Minor to Moderate**
Bats: *Project Impacts*	**Negligible**	**Negligible**
Bats: *Planned Activities without Project Impacts*	**Negligible**	**Negligible**
Bats: *Cumulative Impacts*	**Negligible**	**Negligible**
Birds: *Project Impacts*	**Negligible** to **Minor**	**Negligible** to **Minor**
	Minor Beneficial	**Minor Beneficial**
Birds: *Planned Activities without Project Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Birds: *Cumulative Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Terrestrial Habitats and Fauna: *Project Impacts*	**Minor**	**Minor**
Terrestrial Habitats and Fauna: *Planned Activities without Project Impacts*	**Minor to Moderate**	**Minor to Moderate**
Terrestrial Habitats and Fauna: *Cumulative Impacts*	**Moderate**	**Moderate**
Wetlands and Other Waters of the United States: *Project Impacts*	**Negligible**	**Negligible**
Wetlands and Other Waters of the United States: *Planned Activities without Project Impacts*	**Minor**	**Minor**
Wetlands and Other Waters of the United States: *Cumulative Impacts*	**Minor**	**Minor**
Land Use and Coastal Infrastructure: *Project Impacts*	**Minor**	**Minor**
	Minor Beneficial	**Minor Beneficial**
Land Use and Coastal Infrastructure: *Planned Activities without Project Impacts*	**Minor**	**Minor**
	Minor Beneficial	**Minor Beneficial**
Land Use and Coastal Infrastructure: *Cumulative Impacts*	**Minor**	**Minor**
	Minor Beneficial	**Minor Beneficial**

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

Impact rating colors are as follows: orange = **major**; yellow = **moderate**; blue = **minor**; white = **negligible**; green = **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.

[a] Planned activities without Project impacts includes the impacts evaluated in Alternative A.

[b] Cumulative impacts includes the proposed Project in combination with other ongoing and planned activities.

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Abbreviations and Acronyms

Abbreviation	Definition
§	Section
°C	degrees Celsius
°F	degrees Fahrenheit
24/7	24 hours per day, 7 days per week
µPa	micropascal
µPa2 s	micropascal squared second
µT	microtesla
AC	alternating current
ACP	American Clean Power
A.D.	Anno Domini
ADLS	aircraft detection lighting system
AEP	auditory evoked potential
AFS EWR	Air Force Station Early Warning Radar
AIS	automatic identification system
AMAPPS	Atlantic Marine Assessment Program for Protected Species
AMSL	above mean sea level
APE	area of potential effect
ARSR	Air Route Surveillance Radar
ASR	Airport Surveillance Radar
ASMFC	Atlantic States Marine Fisheries Commission
ATON	aids to navigation
B.P.	before present
BA	Biological Assessment
BMP	best management practice
BO	Biological Opinion
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
COP	Construction and Operations Plan
COVID-19	coronavirus disease 2019
CPT	cone penetrometer testing
CTV	crew transfer vessel
CWA	Clean Water Act
CZM	Massachusetts Office of Coastal Zone Management
DAS	distributed acoustic sensing
dB	decibel
dB re 1 µPa	decibels referenced to 1 micropascal
dBA	A-weighted decibel
DHS	Department of Homeland Security
DoD	Department of Defense
DP	dynamic positioning
DPS	distinct population segment
EFH	essential fish habitat
EIS	Environmental Impact Statement
EMF	electromagnetic fields
EO	Executive Order
ER$_{95\%}$	95 percentile exposure-based range
ESA	Endangered Species Act
ESP	electrical service platform
EWR	early warning radar
FAA	Federal Aviation Administration
Fed. Reg.	Federal Register
FMP	Fisheries Management Plan

Abbreviation	**Definition**
ft	foot
FTE	full-time equivalent
G&G	geological and geophysical
GDP	gross domestic product
GHG	greenhouse gas
GW	gigawatt
HAPC	habitat area of particular concern
HCA	Host Community Agreement
HDD	horizontal directional drilling or drill
HF	high frequency
HFC	high-frequency cetacean
HMS	highly migratory species
HRG	high-resolution geophysical
Hz	hertz
IFR	instrument flight rules
IPF	impact-producing factor
ITA	Incidental Take Authorization
ITS	Incidental Take Statement
kHz	kilohertz
kJ	kilojoule
km	kilometer
km^2	square kilometers
kV	kilovolt
KOP	key observation point
Lpk	peak sound pressure
LE24	cumulative sound exposure level over 24 hours
LFC	low-frequency cetacean
LME	Large Marine Ecosystem
LOA	Letter of Authorization
LRR	long range radar
M/SI	mortality and serious injury
m	meter
m^2	square meter
MA DMF	Massachusetts Division of Marine Fisheries
MAB	Mid-Atlantic Bight
Mayflower Wind	Mayflower Wind Energy Project
MARA	marine archaeological resources assessment
MARIPARS	Massachusetts and Rhode Island Port Access Route Study
Massachusetts	Commonwealth of Massachusetts
MassCEC	Massachusetts Clean Energy Center
MCT	Marine Commerce Terminal
mG	milligaus
MFC	mid-frequency cetacean
MHC	Massachusetts Historical Commission
MLLW	mean lower low water
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MVA	minimum vectoring altitudes
MVR	marine vessel radar
MW	megawatt
NA	not applicable
NARW	North Atlantic right whale
NAS	National Academies
Navy	U.S. Navy
NC	not conclusive
ND	no data
NEFSC	Northeast Fisheries Science Center

Abbreviation	Definition
NEPA	National Environmental Policy Act
NEXRAD	Next Generation Weather Radar
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
nm	nautical miles
NMFS	National Marine Fisheries Service
NNL	National Natural Landmark
No.	number
NOA	Notice of Availability
NOx	nitrogen oxide
NO2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NORAD	North American Aerospace Defense Command
NORM	Navigational and Operational Risk Model
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSRA	navigational safety risk assessment
NVIC	Navigation and Vessel Inspection Circular
NWS	National Weather Service
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OECC	offshore export cable corridor
OECR	onshore export cable route
OEM	original equipment manufacturer
OSRP	oil spill response plan
PAM	passive acoustic monitoring
PATON	private aid to navigation
PAVE/PAWS	precision avionics vectoring equipment/phased array warning system
PBR	potential biological removal
PDE	Project design envelope
$PM_{2.5}$	particulate matter smaller than 2.5 microns
PM_{10}	particulate matter smaller than 10 microns
PPA	power purchase agreement
PPW	phocid pinniped in water
ProvPort	Port of Providence
Project	New England Wind Project
PSO	protected species observer
PST	Preliminary Screening Tool
PTS	permanent threshold shift
RCS	reactive compensation station
RHA	Rivers and Harbors Act of 1899
RI/MA Lease Areas	Rhode Island and Massachusetts Lease Areas
ROD	Record of Decision
ROV	remotely operated vehicle
ROW(s)	right(s)-of-way
SAR	search and rescue
SB	Senate Bill
SCADA	supervisory control and data acquisition
SCV	South Coast Variant
SEL	sound exposure level
$SEL_{24}h$	sound exposure level over 24 hours
SLIA	Seascape and Landscape Impact Assessment
SLVIA	Seascape and Landscape Visual Impact Assessment
SMAST	School for Marine Science and Technology
SO2	sulfur dioxide
SOV	service operation vessel
SPL	sound pressure level

Abbreviation	**Definition**
SPUE	sightings per unit effort
SSU	special, sensitive, and unique
SWDA	Southern Wind Development Area
TCP	traditional cultural property
TDWR	Terminal Doppler Weather Radar
TRACON	Terminal Radar Approach Control
TSHD	trailing suction hopper dredge
TTS	temporary threshold shift
UME	unusual mortality event
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USC	U.S. Code
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
UXO	unexploded ordnance
VFR	Visual Flight Rules
VHF	very high frequency
VIA	Visual Impact Assessment
Vineyard Wind 1	Vineyard Wind 1 Project
VMS	vessel monitoring system
VTR	vessel trip report
WMA	Wildlife Management Area
WSR	Weather Surveillance Radar
WTG	wind turbine generator
ZBW	Boston
ZVI	zone of visual influence
SPL	sound pressure level

1 Introduction

This Draft Environmental Impact Statement (EIS) assesses the potential environmental, social, economic, historic, and cultural impacts that could result from the construction and installation (construction), operations and maintenance (operations), and conceptual decommissioning of the New England Wind Project (Project) proposed by Park City Wind, LLC (Park City Wind, the applicant) in its Construction and Operations Plan (COP; Epsilon 2022a). As described in Section 1.1, the proposed Project consists of two phases: Phase 1, which is also known as the Park City Wind Project, and Phase 2, which is also known as the Commonwealth Wind Project. The proposed Project described in the COP and this Draft EIS would occupy all of the Bureau of Ocean Energy Management's (BOEM) Renewable Energy Lease Number (Lease Area) OCS-A 0534 and potentially a portion of the area covered by Lease Area OCS-A 0501,[1] hereafter referenced collectively as the Southern Wind Development Area (SWDA) (Figure 1.1-1 and Figure 1.1-2). The SWDA is approximately 20 miles from the southwest corner of Martha's Vineyard and approximately 24 miles from Nantucket at its closest point. The proposed Project would be designed to provide commercially sustainable offshore wind energy to meet the need for clean, renewable energy in the northeastern United States. This Draft EIS will inform BOEM in deciding whether to approve, approve with modifications, or disapprove the proposed Project. The publication of a Notice of Availability (NOA) of the Draft EIS initiates a 60-day public comment period on the document. BOEM will use the comments received during the public comment period to inform preparation of the Final EIS.

This Draft EIS was prepared following the requirements of the National Environmental Policy Act (NEPA) (42 U.S. Code [USC] §§ 4321–4370f) and its implementing regulations. The Council on Environmental Quality's (CEQ) current regulations contain a presumptive time limit of 2 years for completing EISs and a presumptive page limit of 150 pages or fewer or 300 pages for proposals of unusual scope or complexity. BOEM has followed those limits in preparing this EIS in accordance with current regulations. Additionally, this Draft EIS was prepared consistent with the U.S. Department of the Interior's NEPA regulations (43 Code of Federal Regulations [CFR] Part 46), longstanding federal judicial and regulatory interpretations, and Biden Administration priorities and policies, including Secretary of the Interior's Order No. 3399 requiring bureaus and offices to not apply any of the provisions of the 2020 changes to CEQ regulations, published in the *Federal Register* at Volume 85, Issue 137 (July 16, 2020) pp. 43304–43376 (85 Fed. Reg. 137 pp.43304–43376), "in a manner that would change the application or level of NEPA that would have been applied to a proposed action before the 2020 Rule went into effect."

The format and organization of the Draft EIS is detailed below:

- Chapter 1, Introduction: this chapter describes the background of the proposed Project, its purpose and need, relevant regulatory considerations, and the methodology used to assess impacts throughout the Draft EIS.
- Chapter 2, Alternatives: this chapter describes the Proposed Action and alternatives including the No Action Alternative.

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[1] The developer of the Vineyard Wind 1 Project (Vineyard Wind 1, LLC) will assign spare or extra positions in the southwestern portion of OCS-A 0501 to Park City Wind for the New England Wind Project if those positions are not developed as part of the Vineyard Wind 1 Project.

- Chapter 3, Affected Environment and Environmental Consequences: this chapter describes the portions of the environment that could be affected by the proposed Project and analyzes the potential impacts of the proposed Project.
- Appendix A, Required Environmental Permits and Consultations: this appendix lists the environmental permits that the proposed Project must obtain, as well as the public, agency, and tribal consultation and coordination that occurred as part of preparing this Draft EIS.
- Appendix B, Supplemental Information and Additional Figures and Tables: this appendix includes supplemental information and tables and figures that do not appear in Chapters 1 through 3 of the Draft EIS.
- Appendix C, Project Design Envelope (PDE) and Maximum-Case Scenario: this appendix includes a detailed description of the PDE.
- Appendix D, Geographical Analysis Areas: this appendix includes a description of the geographical analysis areas for each resource evaluated in the Draft EIS.
- Appendix E, Planned Activities Scenario: this appendix describes the projects included in the planned activities scenario and analyzes the impacts of the proposed Project in combination with projects in that scenario.
- Appendix F, Analysis of Incomplete and Unavailable Information and Other Required Analyses: this appendix describes information pertinent to the analysis in the Draft EIS that is incomplete or unavailable. It also includes the required analyses of unavoidable adverse impacts of the Proposed Action; irreversible and irretrievable commitment of resources; and the relationship between the short-term use of the environment and the maintenance and enhancement of long-term productivity.
- Appendix G, Impact-Producing Factor (IPF) Tables and Assessment of Resources with Minor (or Lower) Impacts: this appendix identifies individual IPFs applicable to each resource, along with the analysis of how the proposed Project and projects in the planned activities scenario contribute to the overall analysis of impacts in Chapter 3.
- Appendix H, Mitigation and Monitoring: this appendix identifies the mitigation and monitoring measures that the applicant has committed to implement, as well as other measures that may result from permitting decisions for the proposed Project.
- Appendix I, Seascape, Landscape, and Visual Impact Assessment: this appendix includes the seascape, landscape, and visual impact assessment prepared for this Draft EIS.
- Appendix J, Finding of Adverse Effect for the New England Wind Project Construction and Operations Plan: this appendix includes the analysis supporting the determination of whether the proposed Project would have an adverse effect on cultural resources, as required under Section 106 of the National Historic Preservation Act (NHPA).
- Appendix K, References Cited: this appendix includes a list of all references cited in the Draft EIS.
- Appendix L, Glossary: this appendix includes a glossary of terms used in the Draft EIS.
- Appendix M, List of Preparers and Reviewers: this appendix includes a list of all preparers and reviewers of the Draft EIS.
- Appendix N, List of Agencies, Organizations, and Persons to Whom Copies of the Statement Are Sent: this appendix includes the list of agencies, groups, and individuals who received the Draft EIS.
- Appendix O, Public Comments and Responses on the Draft Environmental Impact Statement: this appendix will be included as part of the Final EIS and will include the complete compilation of substantive public and agency comments on the Draft EIS, along with identification of individuals and groups who submitted those comments and responses to those comments.

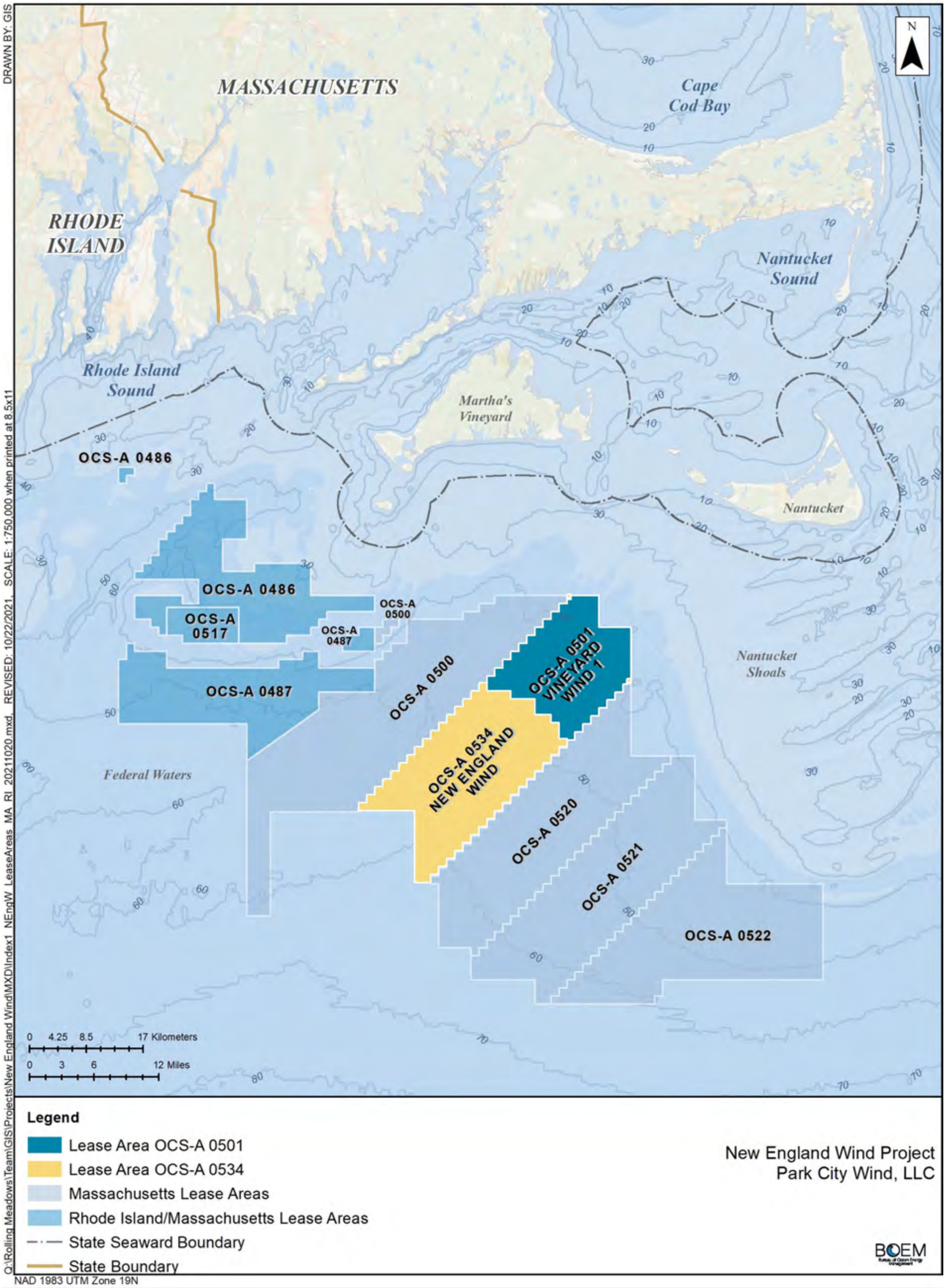
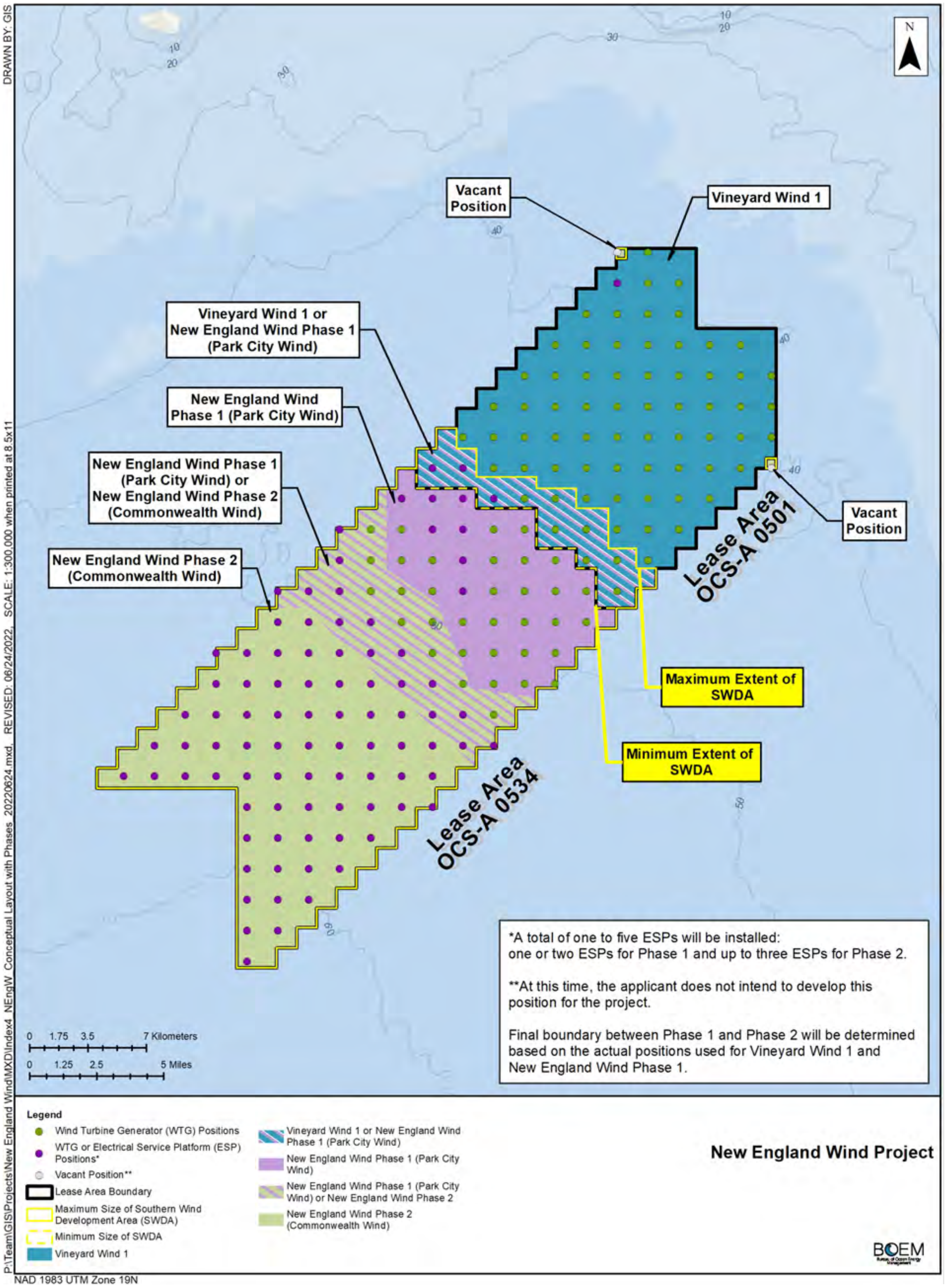


Figure 1.1-1: Proposed Wind Development Area Relative to Rhode Island and Massachusetts Lease Areas



*A total of one to five ESPs will be installed:
one or two ESPs for Phase 1 and up to three ESPs for Phase 2.

**At this time, the applicant does not intend to develop this position for the project.

Final boundary between Phase 1 and Phase 2 will be determined based on the actual positions used for Vineyard Wind 1 and New England Wind Phase 1.

Figure 1.1-2: Proposed Project Overview

1.1 Background

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

In 2009, BOEM established an intergovernmental renewable energy task force to evaluate OCS wind energy offshore the Commonwealth of Massachusetts (Massachusetts). After extensive consultation with the task force, which included elected officials from state, local, and tribal governments, as well as representatives of affected federal agencies, BOEM removed some areas from further consideration for offshore wind leasing to reduce visual impacts, including areas within 12 nautical miles (13.8 miles) of inhabited land. Appendix A describes the detailed steps BOEM then took concerning planning and leasing for the OCS offshore Massachusetts. On April 1, 2015, BOEM held a competitive leasing process as prescribed in 30 CFR § 585.211 and awarded Lease Area OCS-A 0501 to Vineyard Wind 1, LLC.

On June 28, 2021, BOEM assigned 65,296 acres of the area covered by Lease Area OCS-A 0501 to Vineyard Wind 1, LLC. The remaining 101,590 acres were designated as Lease Area OCS-A 0534, which was assigned to the applicant (Figure 1.1-1).[2] The applicant has the exclusive right to submit a COP for activities within area covered by Lease OCS-A 0534. A small portion of the area covered by Lease Area OCS-A 0501 not used for development of the Vineyard Wind 1 Project (Vineyard Wind 1) may also be assigned to the applicant and developed as part of the proposed Project (i.e., the New England Wind Project).[3]

Under the Proposed Action, the proposed Project would be developed in two phases, with a combined maximum of 130 wind turbine generator (WTG) and electrical service platform (ESP) positions, all located within the SWDA. Phase 1, also known as the Park City Wind Project, would deliver approximately 804 megawatts (MW) and would be immediately southwest of Vineyard Wind 1. Phase 2, also known as the Commonwealth Wind Project, would deliver at least 1,232 MW and would be constructed southwest of Phase 1 within the remainder of the SWDA. Collectively, the proposed Project would generate at least 2,036 MW and up to 2,600 MW.

The proposed Project's offshore renewable wind energy facilities would be immediately adjacent to Vineyard Wind 1, which would occupy most of the area covered by Lease Area OCS-A 0501. Five offshore export offshore export cables would transmit electricity generated by the WTGs to onshore transmission systems in the Town of Barnstable and Bristol County, Massachusetts (Avangrid 2022a).

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[2] Except for the description of lease area, which now reflects the two different lease areas, the terms, conditions, and stipulations of the two leases, including the lease effective date of April 1, 2015, remain the same.

[3] Lessees may request to assign a portion of their lease to another qualified legal entity (30 CFR § 585.408).

The proposed Project would also include associated onshore operations and maintenance facilities. For analysis purposes, BOEM assumes that the proposed Project would have a 30-year operating period.[4]

1.2 Purpose of and Need for the Proposed Action

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

The applicant has submitted a COP to BOEM in accordance with BOEM's regulations at 30 CFR §§ 585.620–585.638 proposing the construction, operations, and decommissioning of an offshore wind energy facility in the SWDA (i.e., the proposed Project). The applicant's goal for the proposed Project is to generate at least 2,036 MW of commercially sustainable offshore wind energy from within the SWDA to meet the need for clean, renewable energy in the northeastern United States. Specifically, the applicant's goal for Phase 1 is to deliver 804 MW of power to the ISO New England electric grid to meet the applicant's obligations under long-term contracts with Connecticut electric distribution companies. Phase 1 of the proposed Project would contribute to Connecticut's mandate to obtain 2,000 MW of offshore wind energy by 2030 (as outlined in Connecticut Public Act 19-71) through the applicant's power purchase agreement (PPA) with Connecticut's Public Utilities Regulatory Authority.

The applicant's goal for Phase 2 is to deliver at least 1,232 MW of power to Massachusetts to meet the applicant's obligations under long-term contracts with Massachusetts electric distribution companies. Phase 2 would contribute to the Massachusetts mandate that distribution companies jointly and competitively solicit proposals for offshore wind energy generation (220 Code of Massachusetts Regulations § 23.04(5)).

The applicant submitted a phased COP to BOEM on July 2, 2020, proposing the construction, operations, and decommissioning of offshore wind energy facilities for the proposed Project. A comprehensive update of the COP was submitted in December 2021, and subsequent updates were submitted in April, May, August, September, and November 2022. Currently, BOEM is completing its second-round review of the COP and will approve, approve with modifications, or disapprove the proposed Project. This Draft EIS will inform BOEM's decision in the COP approval process. If its COP is approved, the applicant plans to begin construction in 2023.

The purpose of BOEM's action is to determine whether to approve, approve with modifications, or disapprove the COP for the proposed Project. This purpose reflects BOEM's authority under OCSLA to authorize renewable energy activities on the OCS, as well as EO 14008; the shared goals of the federal agencies to deploy 30 gigawatts (GW) of offshore wind energy capacity in the United States by

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[4] Vineyard Wind 1, LLC's lease with BOEM (Lease Area OCS-A 0501) and Park City Wind's lease with BOEM (Lease Area OCS-A 0534) have 25-year operating periods that commence on the date of COP approval (see https://www.boem.gov/Lease-OCS-A-0501/ at Addendum B; see also https://www.boem.gov/sites/default/files/documents/renewable-energy/OCS-A-0501-Assignment-Approved.pdf; see also 30 CFR § 585.235(a)(3)). Park City Wind would need to request an extension of its operations period from BOEM to operate the proposed Project for 30 years. This Draft EIS analyzes a 30-year operating period to ensure use of the maximum-case scenario and associated adequate NEPA coverage if such an extension is granted.

2030 while protecting biodiversity and promoting ocean co-use (White House 2021); and consideration of the goals of the applicant. BOEM will make this determination after weighing the factors in Subsection 8(p)(4) of the OCSLA that are applicable to plan decisions and considering the above goals.

BOEM's action is needed to fulfill its duties under the lease, which require BOEM to make a decision on the applicant's plans to construct and operate the proposed Project. In addition, the National Marine Fisheries Service (NMFS) anticipates receipt of one or more requests for authorization to take marine mammals incidental to activities related to the proposed Project under the Marine Mammal Protection Act (MMPA). NMFS' issuance of an MMPA Incidental Take Authorization (ITA) is a major federal action, and, in relation to BOEM's action, is considered a connected action (40 CFR § 1501.9(e)(1)). The purpose of the NMFS action—which is a direct outcome of the applicant's request for authorization to take marine mammals incidental to specified activities associated with the proposed Project (e.g., pile driving)—is to evaluate the applicant's request pursuant to specific requirements of the MMPA and its implementing regulations administered by NMFS, consider impacts of the applicant's activities on relevant resources, and, if appropriate, issue the permit or authorization. NMFS needs to render a decision regarding the request for authorization due to NMFS's responsibilities under the MMPA (16 USC § 1371(a)(5)(D)) and its implementing regulations. If NMFS makes the findings necessary to issue the requested authorization, NMFS intends to adopt BOEM's EIS to support that decision and fulfill its NEPA requirements.

The U.S. Army Corps of Engineers (USACE) New England District anticipates a permit action to be undertaken through authority delegated to the District Engineer by 33 CFR § 325.8, under Section 10 of the Rivers and Harbors Act of 1899 (RHA; 33 USC § 403) and Section 404 of the Clean Water Act (CWA; 33 USC § 1344). USACE considers issuance of a permit under these two delegated authorities a major federal action connected to BOEM's Proposed Action (40 CFR § 1501.9(e)(1)).

The basic proposed Project purpose, as determined by USACE for Section 404(b)(1) guidelines evaluation, is offshore wind energy generation. The overall proposed Project purpose for Section 404(b)(1) guidelines evaluation, as determined by USACE, is the construction and operation of a commercial-scale, offshore wind energy project for renewable energy generation and distribution to the New England energy grid. USACE intends to adopt BOEM's EIS to support its decision on any permits requested under Section 10 of the RHA or Section 404 of the CWA.

1.3 Regulatory Overview

The Energy Policy Act of 2005, Public Law 109-58 (74 Fed. Reg. 81 [April 29, 2009]), amended the OCSLA (43 USC § 1331 et seq.) by adding a new Subsection 8(p) that authorizes the Secretary of the Interior to issue leases, easements, and ROWs in the OCS for activities that "produce or support production, transportation, or transmission of energy from sources other than oil and gas," which include wind energy projects.

The Secretary of the Interior delegated this authority to the former Minerals Management Service (MMS) and later to BOEM. Final regulations implementing the authority for renewable energy leasing under OCSLA (30 CFR Part 585) were promulgated on April 22, 2009 (74 Fed. Reg. 81 [April 29, 2009]). These regulations prescribe BOEM's responsibility for determining whether to approve, approve with modifications, or disapprove COPs (30 CFR § 585.628).

Subsection 8(p)(4) of the OCSLA identifies the specific goals that the Secretary of the Interior must consider when evaluating offshore wind energy projects. The Secretary of the Interior has "wide discretion to determine the appropriate balance between two or more goals that conflict or are otherwise in tension" (U.S. Department of the Interior 2021).

Section 2 of Lease OCS-A 0534 provides the lessee with an exclusive right to submit a COP to BOEM for approval. Section 3 provides that BOEM will decide whether to approve a COP in accordance with applicable regulations in 30 CFR Part 585, noting that BOEM retains the right to disapprove a COP based on its determination that the proposed activities would have unacceptable environmental consequences, would conflict with one or more of the requirements set forth in OCSLA Subsection 8(p)(4), or for other reasons provided by BOEM under 30 CFR § 585.613(e)(2) or 585.628(f). BOEM reserves the right to approve a COP with modifications, and BOEM reserves the right to authorize other uses within the leased area that will not unreasonably interfere with activities described in the lease for the proposed Project.

BOEM's evaluation of and decision on the COP are also governed by other applicable federal statutes and implementing regulations, such as NEPA and the Endangered Species Act (ESA; 16 USC §§ 1531–1544). The analyses in this Draft EIS will inform BOEM's decision under 30 CFR § 585.628 for the COP that was submitted in July 2020 and later updated with new information in June 2021, October 2021, December 2021, April 2022, and May 2022 (Epsilon 2022a). BOEM is required to coordinate with federal agencies and state and local governments to ensure that renewable energy development occurs in a safe and environmentally responsible manner. In addition, BOEM's authority to approve activities under the OCSLA only extends to approval of activities on the OCS. Table A.1-1 in Appendix A outlines the federal, state, regional, and local permits and authorizations that are required for the proposed Project and the status of each permit and authorization. Appendix A also provides a description of BOEM's consultation efforts during development of the Draft EIS.

The *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts: Revised Environmental Assessment* (BOEM 2014a) gives a more comprehensive description of BOEM's regulatory authority and decision-making process and is incorporated by reference in Chapter 3, Affected Environment and Environmental Consequences, where appropriate.

This Draft EIS informs BOEM in deciding whether to approve, approve with modifications, or disapprove the COP submitted by the applicant. Before the preparation of the Draft EIS, BOEM conducted a 30-day public comment period and hosted three virtual public scoping meetings to solicit feedback and identify issues and potential alternatives to be considered for the proposed Project. BOEM considered all scoping comments while preparing the Draft EIS, and the most commonly addressed resources or NEPA topics included birds, marine mammals, socioeconomics, and the NEPA process and public engagement. Cooperating agencies can use this Draft EIS to support their decision-making in the approval of the Final EIS and issuance of the Record of Decision (ROD).

1.4 Relevant Existing NEPA and Consulting Documents

BOEM used the following previously prepared NEPA and consulting documents to inform preparation of this Draft EIS; these documents are incorporated by reference where appropriate:

- *Final Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf* (MMS 2007);
- *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Rhode Island and Massachusetts: Revised Environmental Assessment* (BOEM 2013);
- *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts: Revised Environmental Assessment* (BOEM 2014a);
- *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York: Revised Environmental Assessment* (BOEM 2016); and

- *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Continental Shelf* (BOEM 2019a).

Additional environmental studies performed in Massachusetts to support decisions concerning offshore wind energy development are available on BOEM's website (https://www.boem.gov/Massachusetts-Environmental-Studies/).

1.5 Methodology for Assessing the Project Design Envelope

BOEM uses a PDE approach to define and bracket proposed Project characteristics for environmental review and permitting while maintaining a reasonable degree of flexibility to allow the applicant to select and purchase proposed Project components such as WTGs, foundations, submarine cables, and offshore substations.

This Draft EIS assesses the impacts of the PDE described in the COP and presented in Appendix C by using the "maximum-case scenario" process. The maximum-case scenario is composed of each design parameter or combination of parameters that would result in the greatest impact for each physical, biological, and socioeconomic resource. This Draft EIS evaluates potential impacts of the Proposed Action and each action alternative using the maximum-case scenario to assess the design parameters or combination of parameters for each environmental resource (BOEM 2018a). This Draft EIS considers the relationship between aspects of the PDE rather than simply viewing each design parameter independently. Certain resources may have multiple maximum-case scenarios, and the most impacting design parameters may not be the same for all resources. Appendix C explains the PDE approach in more detail and presents a table outlining the design parameters with the highest impact potential by resource for the proposed Project's two phases. Through consultation with its own engineers and outside industry experts, BOEM verified that the maximum-case scenarios analyzed in the Draft EIS could reasonably occur.

1.6 Methodology for Assessing Impacts

In 2019, BOEM released a study of IPFs from renewable energy projects on the North Atlantic OCS (BOEM 2019a). In addition to the cumulative impacts analysis addressing onshore and offshore non-wind activities, this Draft EIS specifically analyzes the cumulative impacts of relevant IPFs from offshore wind by resource. Where possible, BOEM provides a quantitative estimate of these offshore wind impacts. Although these BOEM estimates inform the impact analysis in the Draft EIS, it is not possible to precisely predict future conditions.

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

1.6.1 Past and Ongoing Activities and Trends (Existing Conditions)

Each resource-specific in Chapter 3 of this Draft EIS includes a description of existing conditions of the affected environment. That baseline considers past and present activities in the geographic analysis area, including those related to offshore wind projects with an approved COP (e.g., the Vineyard Wind 1 Project [Vineyard Wind 1] in Lease Area OCS-A 0501 and the South Fork Wind Project in Lease Area OCS-A 0517) and approved past and ongoing site assessment surveys, as well as other non-wind activities (e.g., Navy military training, existing vessel traffic, climate change). The existing condition of resources as influenced by past and ongoing activities and trends comprises the existing baseline condition for impact analysis. Other factors currently affecting the resource, including climate change, are also acknowledged for that resource and are included in the impact-level conclusion.

BOEM also analyzes potential impacts on resources that could result from the proposed Project and alternatives to the Proposed Action. Additionally, BOEM evaluates the combination of those impacts with impacts from ongoing and planned activities. The potential impacts resulting from the Proposed Action are compared to the No Action Alternative, and potential impacts resulting from the alternatives are compared to the Proposed Action and each other.

1.6.2 Planned Activities

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

1.6.3 Impacts Resulting from Climate Change

Impacts from climate change have already influenced the current conditions of some resources and will likely continue to influence the future baseline conditions. An analysis of environmental trends and climate change impacts is introduced in the No Action Alternative and assessed as part of the combined impacts resulting from action alternatives for each resource. A more detailed discussion of climate change (e.g., sea level rise, ocean acidification) is provided in Appendix E.

The atmosphere, ocean, and land have warmed as a result of human influence, and widespread and rapid changes in the atmosphere, ocean, cryosphere, and biosphere have occurred. Observed warming is driven by emissions from human activities, such as fossil-fueled power-generating facilities. Local emissions, such as those from the construction of wind energy projects, contribute to global emissions, and global emissions are having increasing impacts on local conditions. However, as renewable energy projects begin operating and replacing fossil fuel-powered generating facilities (current and/or future facilities needed to meet energy demands), overall power generation emissions could decrease.

2 Alternatives

This chapter describes the alternatives considered for the proposed Project, including the Proposed Action, No Action Alternative, and two additional action alternatives (Table 2.1-1); describes the non-routine activities and low-probability events that could occur during construction and installation (construction), operations and maintenance (operations), and conceptual decommissioning (decommissioning) of the proposed Project; and presents a summary and comparison of impacts among alternatives and resources affected.

2.1 Alternatives Analyzed in Detail

BOEM considered a reasonable range of alternatives during the EIS development process that emerged from scoping, interagency coordination, and internal BOEM deliberations. Alternatives were reviewed using BOEM's screening criteria, described in Section 2.2. Alternatives that did not satisfy the screening criteria (i.e., were found to be infeasible or did not meet the purpose and need) were dismissed from detailed analysis in this Draft EIS. Alternatives considered but dismissed from detailed analysis and the rationale for their dismissal are described in Section 2.2. The alternatives carried forward for detailed analysis in this Draft EIS are summarized in Table 2.1-1 and described in detail in Sections 2.1.1 through 2.1.3. Table 2.1-2 summarizes scenarios for Phase 2 export cable installation. The alternatives listed in Table 2.1-1 are not mutually exclusive. BOEM may select elements of multiple listed Draft EIS alternatives resulting in a preferred alternative identified in the Final EIS provided that the design parameters are compatible and the preferred alternative still meets the purpose and need.

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

NMFS and the USACE are serving as cooperating agencies and intend to adopt the Final EIS after independent review and analysis to meet their NEPA compliance requirements. Under the Proposed Action and other action alternatives, NMFS' action is to issue the requested Letter of Authorization to the applicant authorizing incidental take under the MMPA for the activities specified in its application and that are being analyzed by BOEM in the reasonable range of alternatives described in this chapter. The USACE is required to analyze alternatives for the proposed Project that are reasonable and practicable pursuant to NEPA and the CWA Section 404(b)(1) Guidelines. The range of alternatives analyzed in the Draft EIS, including alternatives considered but dismissed, represents a reasonable range of alternatives for this analysis.

BOEM decided to use the NEPA substitution process for NHPA Section 106 purposes, pursuant to 36 CFR § 800.8(c), during its review of the proposed Project. Regulations implemented pursuant to Section 106 of the NHPA, Protection of Historic Properties (36 CFR Part 800, specifically 36 CFR § 800.8(c)), provides for use of the NEPA substitution process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR §§ 800.3 through 800.6. Draft avoidance, minimization, and mitigation measures to resolve impacts on historic properties are presented in Appendix H, Mitigation and Monitoring. Ongoing consultation with consulting parties and government consultation with tribal nations may result in additional measures or changes to these measures.

Table 2.1-1: Alternatives Considered for Analysis

Alternative	Description
Alternative A (No Action Alternative)	**<u>Under Alternative A</u>**, Under Alternative A, BOEM would not approve the COP; the proposed Project construction, operations, and decommissioning would not occur; and no additional permits or authorizations for the proposed Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the proposed Project as described under the Proposed Action would not occur. However, all other past and ongoing impact-producing activities would continue. Under Alternative A, impacts on marine mammals incidental to construction activities would not occur. Therefore, NMFS would not issue the requested authorization under the MMPA to the applicant. The current resource condition, trends, and impacts from ongoing activities under Alternative A serve as existing conditions against which the direct and indirect impacts of all action alternatives are evaluated. Over the life of the proposed Project, other reasonably foreseeable future impact-producing offshore wind and non-offshore wind activities would be implemented, which would cause changes to existing conditions even in the absence of the Proposed Action. The continuation of all other existing and reasonably foreseeable future activities described in Appendix E, Planned Activities Scenario, without the Proposed Action serves as the baseline for the evaluation of cumulative impacts.
Alternative B (Proposed Action)	**<u>Under Alternative B</u>**, the construction, operations, and decommissioning of a wind energy facility in the SWDA offshore Massachusetts would consist of the components described below: • Up to 132 total foundations for 125 to 129 WTGs and 1 to 5 ESPs would be installed in 130 positions, generating at least 2,036 MW and up to 2,600 MW of electricity to meet existing and potential future offtake demands for New England states. This equates to an approximate minimum nameplate capacity of 16 MW per WTG. • If two ESPs are used for Phase 1, the applicant states that each ESP could occupy one of the 130 positions in the SWDA, or the two ESPs could be co-located at a single position, with each ESP's monopile foundation located within 250 feet of that position (i.e., the monopiles would be separated by up to 500 feet). Similarly, if two or three ESPs are used for Phase 2, each ESP could occupy one of the 130 positions in the SWDA, or two of the ESPs could be co-located at a single position (COP Volume I, Sections 3.2.1.3 and 4.2.1.3; Epsilon 2022a). As a result, Phase 1 could include 63 foundations at 62 positions, and Phase 2 could include 89 foundations at 88 positions—a total of 132 foundations at 130 positions.[a] • Inter-array cables would be installed, linking the individual WTGs to the ESPs and inter-link cables between ESPs. • Five offshore electrical transmission cables, including two for Phase 1 and three for Phase 2, would be installed in an OECC through Muskeget Channel (including the Western Muskeget Variant).[b] Table 2.1-2 provides the Phase 2 export cable scenarios. Landing sites for Phase 1 cables would be in Barnstable County, Massachusetts. Intended landing sites for Phase 2 cables would also be in Barnstable County, except if the SCV is implemented (see below). • Onshore electrical cables, grid interconnection cables, and up to three new or upgraded substations would be installed in Barnstable County, Massachusetts (including, but not limited to, the existing West Barnstable Substation). • Under BOEM's phased development regulation (30 CFR § 585.629), conditional approval of the SCV would be required. The SCV could include up to three offshore electrical transmission cables for Phase 2 only (in lieu of or in addition to the proposed route through Muskeget Channel) with a cable landing site, onshore transmission cable, grid interconnection, and new or upgraded substations in Bristol County, Massachusetts. The SCV is conceptual and a contingency route with limited details included in the COP (Epsilon 2022a) for review at this time. Should the SCV be approved, its approval would be conditional, subject to the submission of a revised COP, additional reviews under NEPA and OCSLA, and subject to potential additional consultations. Selection of the SCV could also necessitate upgrades to existing substations in Bristol County not currently envisioned by substation operators or ISO-NE.[c] Development of the proposed Project would occur within the range of design parameters outlined in the COP (Epsilon 2022a), subject to applicable mitigation and monitoring measures.

Alternative	Description
Alternative C (Habitat Impact Minimization Alternative)	**Under Alternative C**, the construction, operations, and decommissioning of a wind energy facility on the OCS offshore Massachusetts would occur within the range of the design parameters outlined in the proposed Project COP (Epsilon 2022a), subject to applicable mitigation and monitoring measures. However, this alternative would limit the available scenarios for the Phase 2 export cable routes and configurations to minimize impacts on complex fisheries habitats in Muskeget Channel, compared to Alternative B.[b] • **Alternative C-1, Western Muskeget Variant Avoidance**. This alternative would preclude use of the Western Muskeget Variant, limiting available scenarios to those that include only the Eastern Muskeget route and SCV (Scenarios 1, 3, 5, and 6 in Table 2.1-2). Avoiding use of the Western Muskeget Variant would avoid a crossing of a proposed export cable route for the Mayflower Wind Energy Project within the Western Muskeget Channel and limit the total number of potential crossings of the Mayflower Wind cable to a single crossing south of Muskeget Channel. This area of the proposed cable crossing south of Muskeget Channel has potentially less biogenic structure than the additional crossing that would occur within the channel if the Western Muskeget Variant route were used. Figure 2.1-1 provides approximate mapping of the proposed Project and Mayflower Wind export cable routes, including potential areas of cable crossings. • **Alternative C-2, Eastern Muskeget Route Minimization.** This alternative would minimize, to the degree practicable, the use of the Eastern Muskeget route and maximize the use of the Western Muskeget Variant and/or the SCV (Scenarios 5 and 6 in Table 2.1-2) for all Phase 2 export cables. Under this alternative, the two Phase 1 cables would be installed in the Eastern Muskeget route, along with a maximum of one Phase 2 cable. This eliminates the option for a total of two to three Phase 2 cables to be installed in the Eastern Muskeget route. This alternative could potentially reduce impacts on productive complex habitats along the Eastern Muskeget route compared to Alternative B. Scenarios 5 and 6 would require significant delays to Phase 2 due to the need to upgrade substation(s) connected to ISO-NE that are not currently planned for upgrade. The applicant states that Scenarios 5 and 6 would require significant delays to Phase 2 due to the need to upgrade substations connected to ISO-NE that are not currently planned for upgrade (Avangrid 2022a).

BOEM = Bureau of Ocean Energy Management; CFR = Code of Federal Regulations; COP = Construction and Operations Plan; ESP = electrical service platform; MMPA = Marine Mammal Protection Act; MW = megawatt; NEPA = National Environmental Policy Act; NHPA = National Historic Preservation Act; OCS = Outer Continental Shelf; OCSLA = Outer Continental Shelf Lands Act; OECC = offshore export cable corridor; RI/MA Lease Areas = Rhode Island and Massachusetts Lease Area; SCV = South Coast Variant; SWDA = Southern Wind Development Area; WTG = wind turbine generator

[a] The COP seafloor disturbance tables (Appendix III-T; Epsilon 2022a), acoustic impacts (Appendix III-M; Epsilon 2022a), the Navigation Safety Risk Assessment (COP Appendix III-I; Epsilon 2022a), Marine Archaeological Resources Assessment (COP Appendix II-D; Epsilon 2022a), and air emissions (COP Appendix III-B; Epsilon 2022a) incorporate 132 foundations in 130 WTG/ESP positions (Maria Hartnett, Pers. Comm, November 15, 2022).

[b] The applicant states that "With the rapid advancement of WTG technology, it is possible that an additional offshore export cable could be needed for New England Wind. If used, the additional cable would remain within the existing offshore export cable corridor or variants assessed and would not exceed the impacts analyzed for each corridor or variant" (COP Volume I, Section S-1; Epsilon 2022a). If an additional cable is proposed, the applicant would be required to file a COP revision per 30 CFR § 585.634, describing the need for this cable and providing the information necessary to complete a sufficient analysis. In response, BOEM would complete additional environmental analysis and relevant consultations required by NEPA, NHPA, and other applicable statutes to inform BOEM's decision to approve, approve with conditions, or disapprove the COP revision.

[c] If the SCV is necessary, the applicant would be required to file a COP revision per 30 CFR § 585.634, describing the need for the SCV and providing the information necessary to complete a sufficient analysis. In response, BOEM would complete additional environmental analysis and relevant consultations required by NEPA, NHPA, and other applicable statutes to inform BOEM's decision to approve, approve with conditions, or disapprove the COP revision.

Table 2.1-2: Export Cable Scenarios

Phase 2 OECC Routes	**Number of Phase 2 Cables by Scenario**					
	1	**2**	**3**	**4**	**5**[a]	**6**[a]
Eastern Muskeget OECC	3	2	2	1	1	0
Western Muskeget Variant OECC	0	1	0	2	0	0
SCV OECC[b]	0	0	1	0	2	3

Source: COP Volume I, Table 4.1-2; Epsilon 2022a

BOEM = Bureau of Ocean Energy Management; CFR = Code of Federal Regulations; COP = Construction and Operations Plan; NEPA = National Environmental Policy Act; NHPA = National Historic Preservation Act; OECC = offshore export cable corridor; SCV = South Coast Variant

[a] The applicant states that Scenarios 5 and 6 are theoretically possible but unlikely and would require significant delays to Phase 2 due to the need to upgrade substations connected to ISO-NE that are not currently planned for upgrade (Avangrid 2022a).

[b] If the SCV is necessary, the applicant would be required to file a COP revision per 30 CFR § 585.634, describing the need for the SCV and providing the information necessary to complete a sufficient analysis. In response, BOEM would complete additional environmental analysis and relevant consultations required by NEPA, NHPA, and other applicable statutes to inform BOEM's decision to approve, approve with conditions, or disapprove the COP revision.

Figure 2.1-1: Mayflower Wind Project and New England Wind Project Offshore Export Cable Corridor Routes in Muskeget Channel

2.1.1 Alternative A – No Action Alternative

Under Alternative A, BOEM would not approve the COP. Proposed Project construction, operations, and decommissioning would not occur, and no additional permits or authorizations for the proposed Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the proposed Project, as described under Alternative B, would not occur. However, all other past and ongoing impact-producing activities would continue. Under Alternative A, impacts on marine mammals incidental to construction activities would not occur. Therefore, NMFS would not issue the requested authorization under the MMPA to the applicant. The current resource condition, trends, and impacts from ongoing activities under Alternative A serve as existing conditions against which the direct and indirect impacts of all action alternatives are evaluated.

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

2.1.2 Alternative B – Proposed Action

Under Alternative B, the applicant would be authorized to construct, operate, and decommission wind energy facilities generating at least 2,036 MW, along with associated offshore and onshore cabling, onshore substations, and onshore operations facilities. This proposed Project would be developed in two phases, with a maximum of 130 WTG and ESP positions. Three to five offshore export cables would transmit electricity generated by the WTGs to onshore transmission systems in the Town of Barnstable or in Bristol County, Massachusetts. Figure 1.1-1 provides an overview of the proposed Project.

The proposed Project's WTGs and ESPs would be immediately southwest of Vineyard Wind 1. The proposed Project would occupy all of Lease Area OCS-A 0534 and potentially a portion of Lease Area OCS-A 0501 (collectively the SWDA). This additional portion could be included if Vineyard Wind 1 does not develop the spare or extra positions included in the area covered by Lease Area OCS-A 0501 and BOEM assigns those positions to Lease Area OCS-A 0534. Two aliquots (small areas of the ocean surface) adjacent to but outside of Lease Area OCS-A 0501 are within Lease Area OCS-A 0534 but would not contain any proposed Project elements.

The SWDA would occupy 101,590 to 111,939 acres depending on whether any of the Vineyard Wind 1 positions are assigned to the proposed Project. The SWDA is slightly more than 20 miles southwest of Martha's Vineyard, Massachusetts, and approximately 24 miles south of Nantucket, Massachusetts. The WTGs and ESPs in the SWDA would be oriented in an east-to-west, north-to-south grid pattern with 1-nautical-mile (1.9-kilometer, 1.15-mile) × 1-nautical-mile (1.9-kilometer, 1.15-mile) spacing between positions.

The applicant has committed to measures as part of the proposed Project to avoid or minimize impacts on physical, biological, socioeconomic, and cultural resources (COP Volume III, Section 4; Epsilon 2022a). These measures are described in Appendix H and are incorporated as part of Alternative B.

The applicant would advance the proposed Project within the PDE summarized in Appendix C, Project Design Envelope and Maximum-Case Scenario. Additional details of Alternative B are contained in the COP (Volume I; Epsilon 2022a).[5]

2.1.2.1 Monitoring and Surveys Committed to by the Applicant

As part of Alternative B, the applicant has committed to conducting monitoring surveys before, during, and after construction (Table 2.1-3). The applicant is voluntarily conducting pre-construction surveys under existing permits. A description of specific survey activities is provided in the respective resource sections in Chapter 3, Affected Environment and Environmental Consequences. BOEM's review under OCSLA and Section 7 of the ESA and consultations under the ESA and the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as well as reviews under other applicable statutes, including the MMPA and Coastal Zone Management Act, may result in additional measures or changes to these measures.

Table 2.1-3: Monitoring Surveys

Monitoring Survey	Project Stage	Chapter 3 Resource Section
Fisheries monitoring plan	Pre-construction, construction, and operations	Commercial Fisheries and For-Hire Recreational Fishing
Benthic monitoring plan	Pre-construction, construction, and operations	Benthic Resources
Protected species mitigation and monitoring plan: marine mammals, sea turtles, and ESA-listed fish	Pre-construction, construction, and operations	Finfish, Invertebrates, and Essential Fish Habitat; Marine Mammals; Sea Turtles
Avian and bat post-construction monitoring framework	Operations	Bats; Birds

ESA = Endangered Species Act

2.1.2.2 Phase 1 (Park City Wind Project)

Phase 1, also known as the Park City Wind Project, would be developed immediately southwest of Vineyard Wind 1. Phase 1 would have a total generating capacity of up to 804 MW and consist of 41 to 62 WTGs and up to 2 ESPs (Table C-1 in Appendix C).

Phase 1 Construction and Installation

Phase 1 includes the construction of both onshore and offshore facilities. Onshore construction of Phase 1 would likely begin in 2023, and offshore construction would likely begin in late 2024 (COP Volume I, Section 3.3.2; Epsilon 2022a). Onshore substation construction would begin in the fourth quarter 2023, onshore export cable route (OECR) construction would begin in first quarter 2024; construction within the offshore export cable corridor (OECC) would begin in fourth quarter 2024; and WTG, ESP, and inter-array cable installation would begin second quarter 2025. Construction would be complete by fourth quarter 2025 (COP Volume I, Section 3.3.2; Epsilon 2022a).

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[5] The COP can be accessed at https://www.boem.gov/renewable-energy/state-activities/vineyard-wind-south-construction-and-operations-plan.

Onshore Activities and Facilities

Onshore proposed Project elements include the Town of Barnstable Landfall Site, the onshore export cables from the landfall site to the onshore substation, the onshore substation site, and the connection from the proposed substation site to the existing bulk power grid (Figure 2.1-2).

The Phase 1 offshore export cables would make landfall within paved parking areas at either the Craigville Public Beach Landfall Site or the Covell's Beach Landfall Site in the Town of Barnstable. The ocean-to-land transition at either landfall site would employ the horizontal directional drill (HDD) technique, which would avoid or minimize impacts on the beach, intertidal zone, and nearshore areas.

The applicant would construct one or more underground concrete transition vaults, also called splice vaults, at the landfall site. These would be accessible after construction via a manhole. Inside the splice vault(s), the 220 to 275 kilovolt (kV) alternating current (AC) offshore export cables would be connected to the 220 to 275 kV onshore export cables. From the landfall site to the proposed substation site, the Phase 1 OECR would be approximately 6.5 miles long, depending on the cable landfall site and route variant selected. The route options and variants are shown on Figure 2.1-2 (COP Volume I, Section 3.2.2.2; Epsilon 2022a). Onshore export cables would be placed in a single concrete duct bank that would primarily be installed via open trenching within public roadway layouts (either beneath the road or within 10 feet of the pavement), although portions of the duct bank could be within existing utility ROWs.

The duct bank could vary in size along its length, although the typical trench for the duct bank would be 8 feet deep, 5.5 feet wide at the bottom, and 11 feet wide at the top. Excavated areas for splice vaults, either at the landfall site or along the OECR, would measure approximately 20 feet wide by 50 feet long. The top of the duct bank would typically have a minimum of 3 feet of cover comprised of properly compacted sand topped by pavement.

Most of the proposed OECR would pass through already developed areas, primarily paved roads, and existing utility ROWs. The OECR would be entirely underground. Duct bank system installation would typically occur outside of the summer peak tourist season, where feasible, to minimize traffic disruption. All work would be performed in accordance with local, state, and federal safety standards, and any applicant-specific requirements. The duct bank could vary in size and orientation along its length and could be installed either as a flat layout (four conduits wide by two conduits deep) or as an upright layout (two conduits wide by four conduits deep).

The Phase 1 onshore export cables would terminate at the proposed substation site on an approximately 6.7-acre commercial property at 8 Shootflying Hill Road. If necessary for engineering or other reasons, some of the onshore substation equipment currently intended for the 8 Shootflying Hill Road site could instead be placed on the 2.8-acre Parcel #214001 immediately southeast of (and adjoining) the West Barnstable Substation. Construction would advance similarly on either site. The applicant has also acquired the 1-acre property at 6 Shootflying Hill Road and would construct an access road on this property to reach the 8 Shootflying Hill Road onshore substation site. Construction of the onshore substation would take approximately 18 to 24 months.

Ground-disturbing activities during onshore substation construction include excavation and grading. The applicant anticipates the entire 8 Shootflying Hill Road site would need to be cleared to accommodate grading and access, as would the entire 6 Shootflying Hill Road parcel. Clearance of Parcel #214-001 would also be necessary if the parcel is used for the proposed Project. The applicant would plant a vegetated screening on the western and northern boundaries of the onshore substation site, providing visual screening for existing residences. The eastern boundary could be used for part of the perimeter access drive, and the abutting land is undeveloped wooded land. The entire site would have a perimeter access fence, and the western edge could have sound attenuation walls, if necessary.

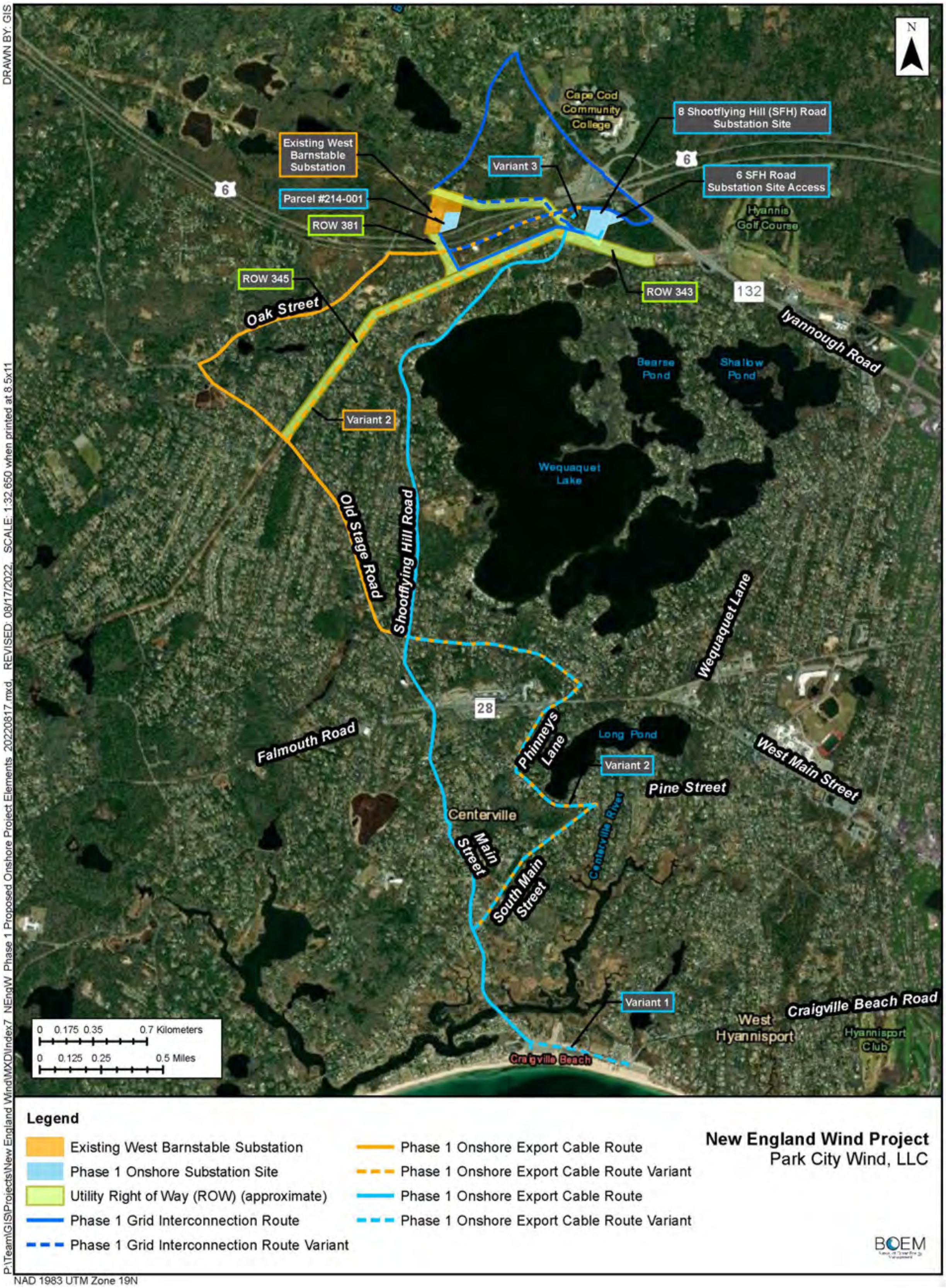


Figure 2.1-2: Proposed Phase 1 Onshore Elements

Phase 1 would connect into the ISO New England electric grid (the regional electrical grid) via Eversource's existing 345 kV West Barnstable Substation. The proposed Project would install cables along a grid interconnection route, which would run up to 1.8 miles, depending on the route selected (Figure 2.1-2). As with the OECR, the grid interconnection route would be installed within public roadway layouts (either beneath the road or within 10 feet of the pavement) or entirely within existing utility ROWs. The 345 kV grid interconnection cables would be the same type of cable as the onshore export cables and installed in an underground duct bank with the same maximum dimensions as those described for the OECR.

Modifications and an expansion at the West Barnstable Substation would also be required to accommodate Phase 1. ISO New England and Eversource would determine the design and schedule of this work, which could include installation of an additional transformer and associated electrical transmission equipment (COP Volume I, Section 3.2.2; Epsilon 2022a). It is anticipated that the West Barnstable Substation expansion could occur between the existing substation and the Oak Street Substation on the northern part of the same parcel.

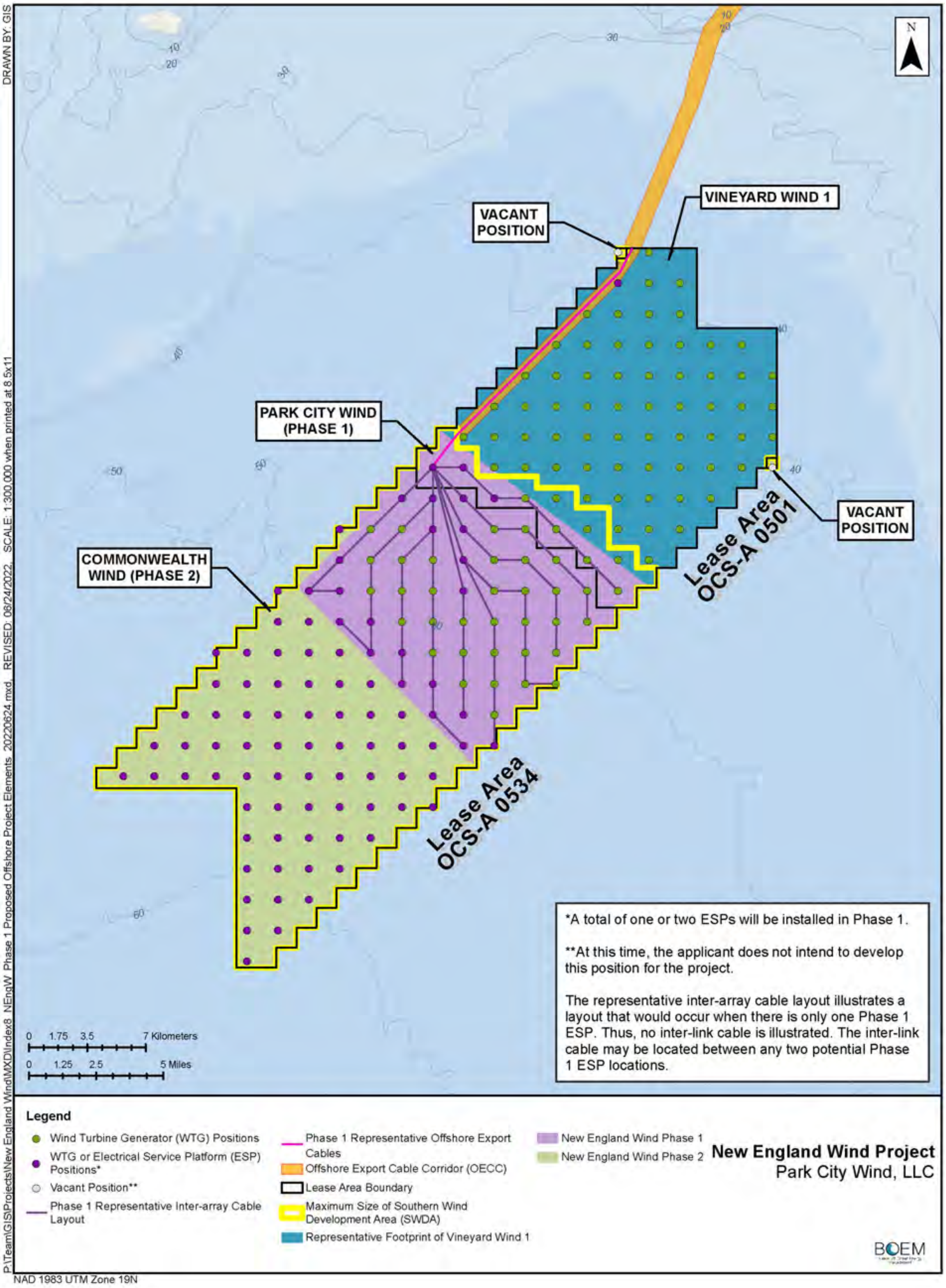
Offshore Activities and Facilities

Offshore proposed Project components for Phase 1 include WTGs and their foundations, ESPs and their foundations, scour protection for all foundations, inter-array cables that connect the WTGs to the ESPs, the inter-link cables that connect the ESPs, and the export cables to the landfall location (Figures 2.1-3 and 2.1-4). The offshore proposed Project elements are within federal waters. Export cables installed within 3 nautical miles (3.5 miles) of shore in waters managed jointly by federal agencies and the Commonwealth of Massachusetts. The COP provides a detailed description of proposed construction methods (Volume I, Section 3.3.1; Epsilon 2022a).

The applicant would install up to 62 WTGs with maximum nacelle-top heights of 725 feet above mean lower low water (MLLW) and maximum vertical blade tip extension of 1,171 feet MLLW. Figure 2.1-5 provides a schematic drawing of the maximum WTG design parameters. The applicant would mount Phase 1 WTGs on monopile or jacket foundations. A monopile (Figure 2.1-6) is a long steel tube driven up to 180 feet into the seabed. A jacket foundation (Figure 2.1-7) is a latticed steel frame with three or four supporting pin piles driven up to 279 feet into the seabed. Additional schematic drawings and photos of proposed foundation types are included in the COP (Volume I, Section 4.2.1.1; Epsilon 2022a).

Each Phase 1 WTG would contain approximately 3,012 gallons of transformer oil, approximately 1,820 gallons of general oil (for hydraulics and gearboxes), and approximately 1,849 gallons of diesel fuel. Use of other chemicals would include coolants/refrigerants, grease, paints, and sulfur hexafluoride (COP Volume I, Table 4.3-7; Epsilon 2022a).

The applicant would construct one or two ESPs in the SWDA to serve as the interconnection point between the WTGs and the export cables. The ESPs would be located along the northwestern edge of the SWDA and include step-up transformers and other electrical equipment needed to connect the 66 to 132 kV inter-array cables to the 220 to 275 kV offshore export cables. Each inter-array cable would be buried below the seabed and connect a string consisting of multiple WTGs to the ESP. The number and orientation of the inter-array cables would depend on the exact WTG and ESP positions used. If the proposed Project uses more than one ESP, a 66 to 275 kV inter-link cable would be installed to connect the ESPs.



*A total of one or two ESPs will be installed in Phase 1.

**At this time, the applicant does not intend to develop this position for the project.

The representative inter-array cable layout illustrates a layout that would occur when there is only one Phase 1 ESP. Thus, no inter-link cable is illustrated. The inter-link cable may be located between any two potential Phase 1 ESP locations.

Figure 2.1-3: Proposed Phase 1 Offshore Elements

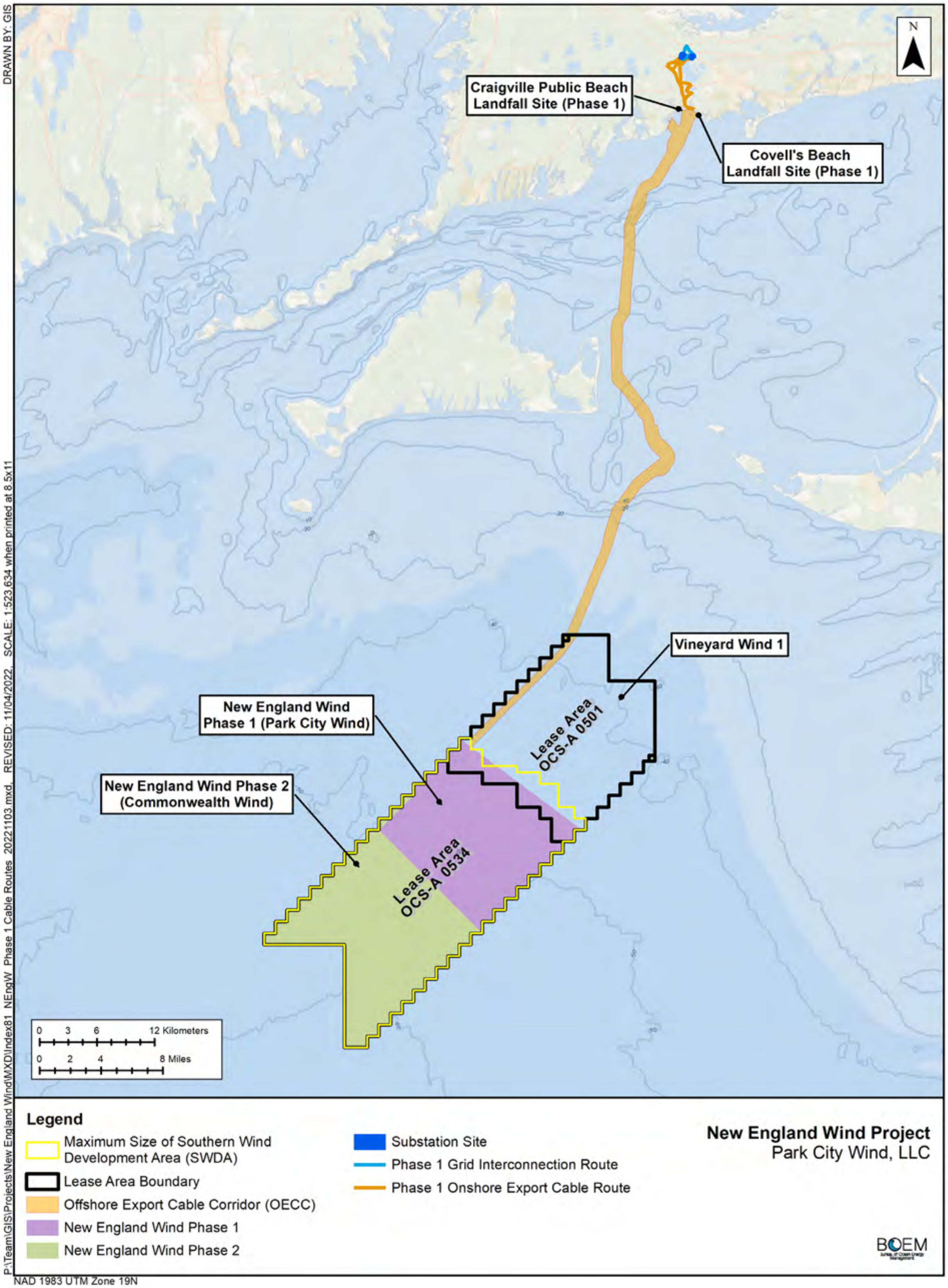
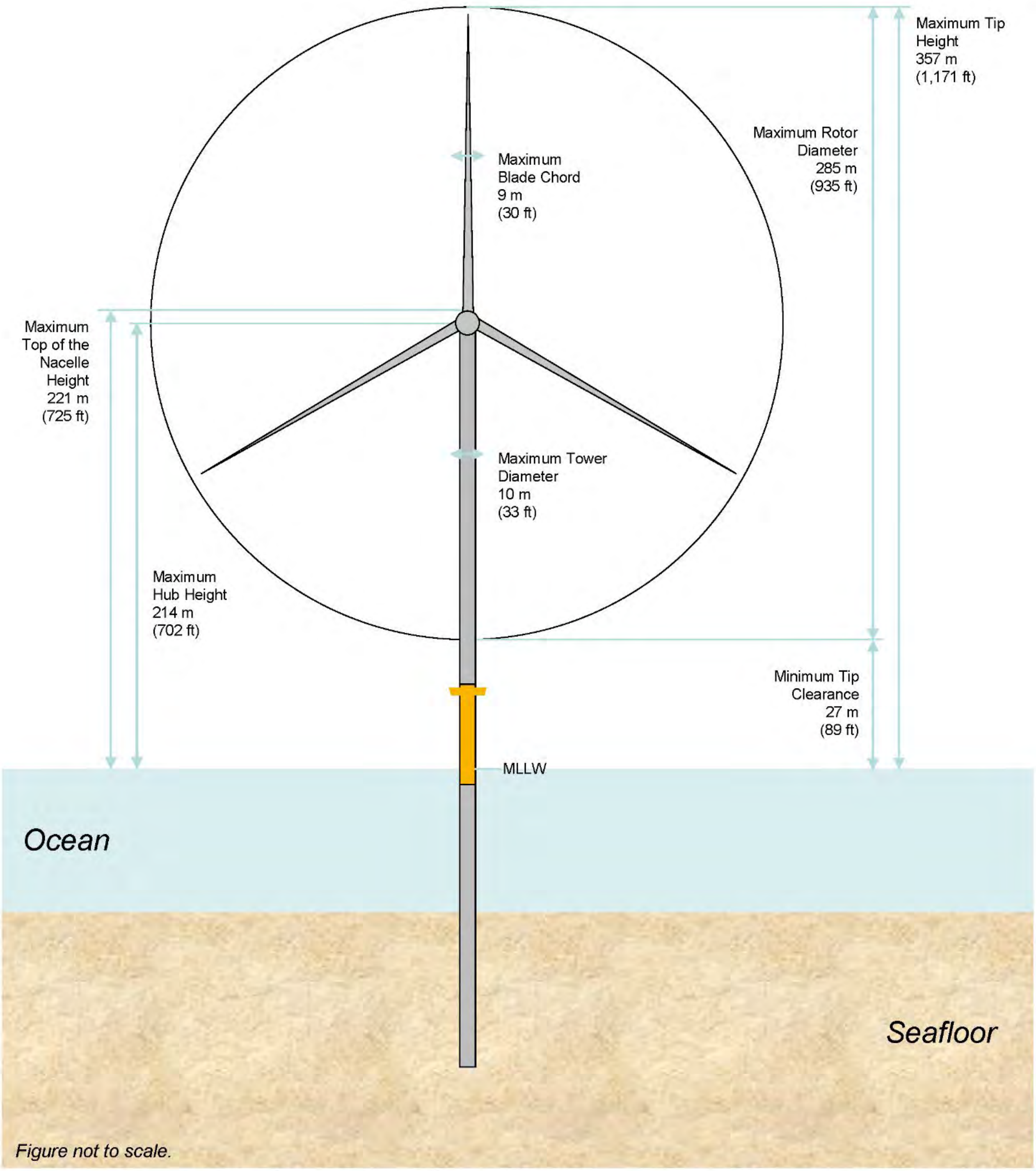
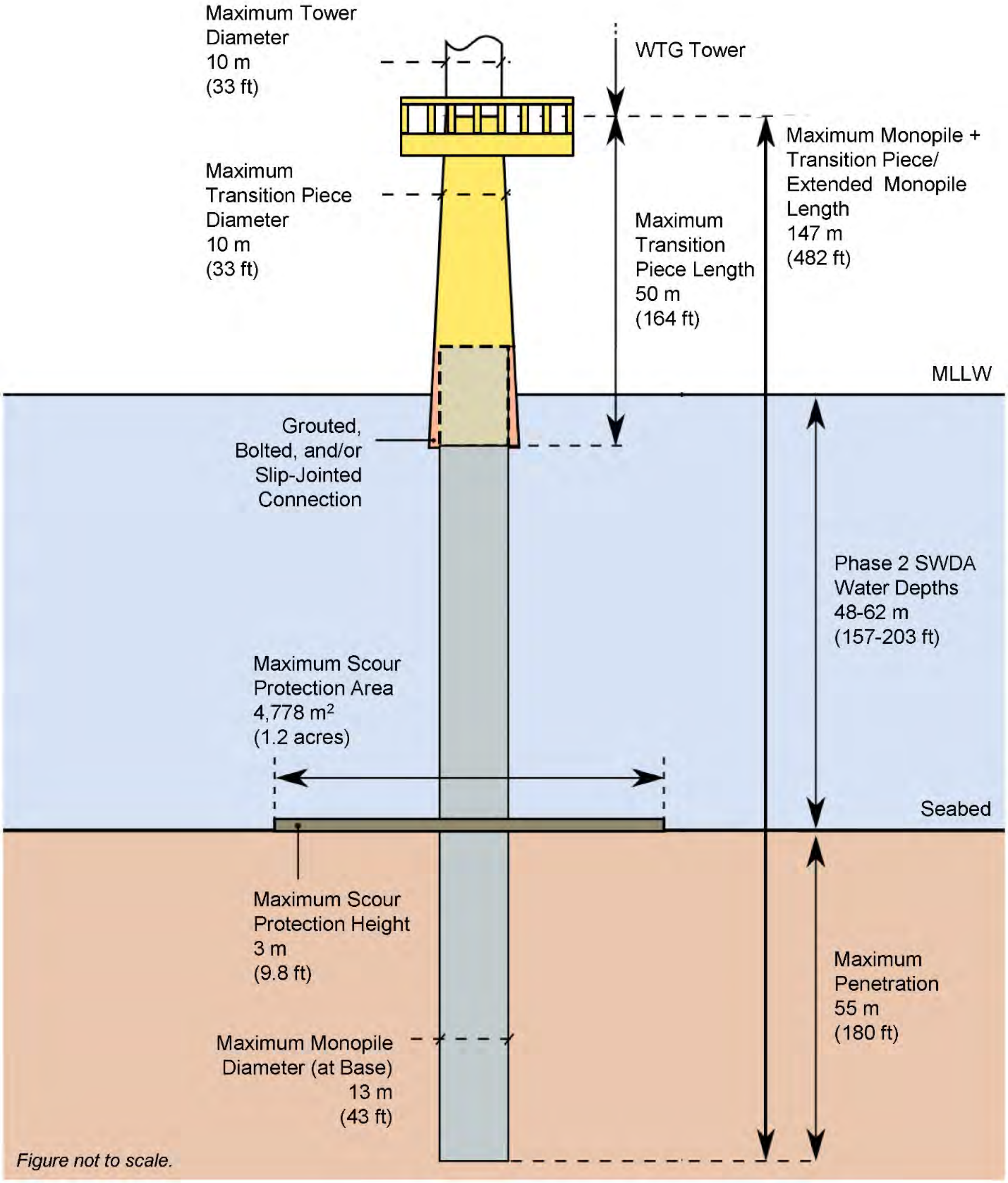


Figure 2.1-4: Proposed Phase 1 Export Cables



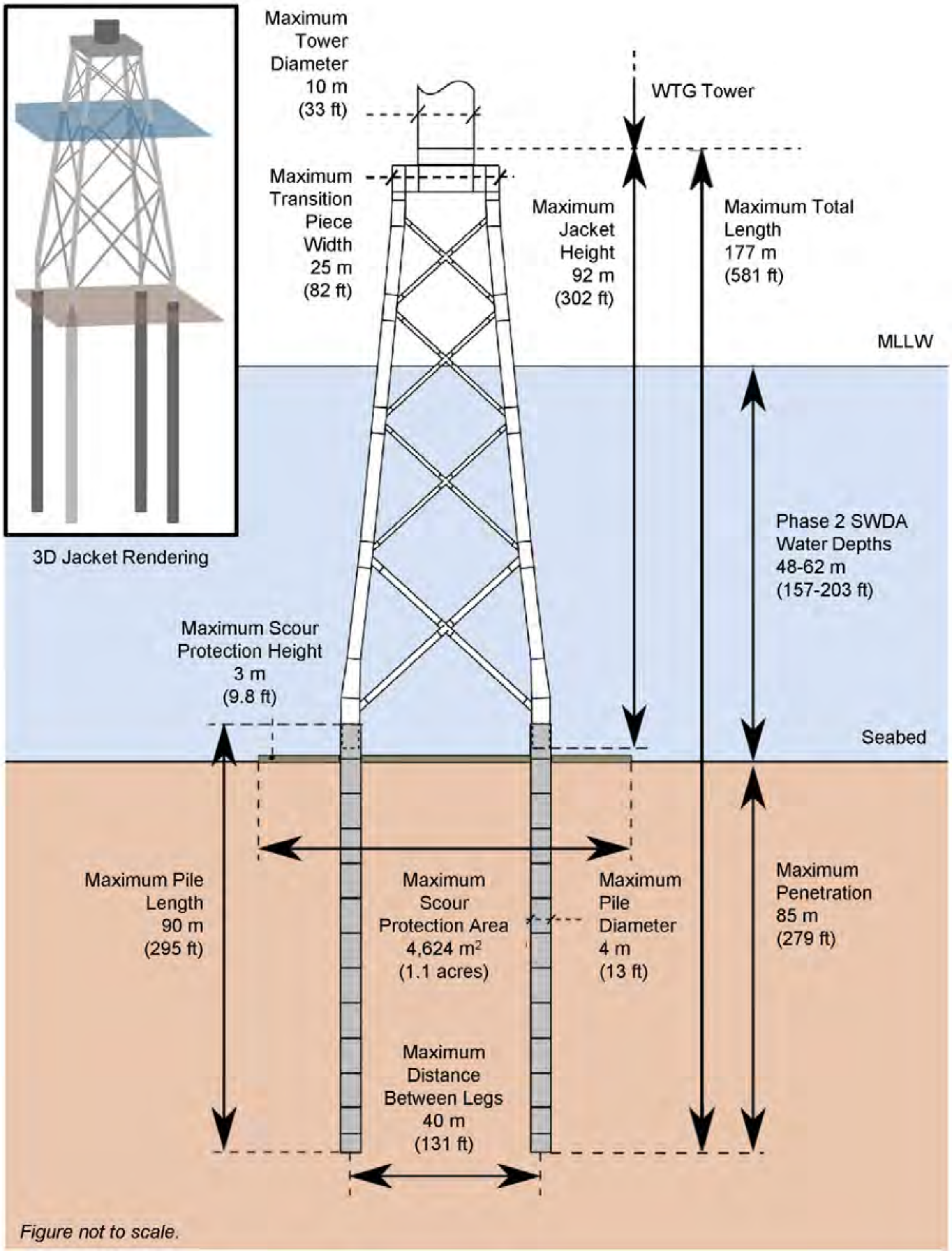
Source: COP Volume I, Section 4.2.1; Epsilon 2022a
ft = feet; m = meter; MLLW = mean lower low water

Figure 2.1-5: Phase 1 Maximum-Case Schematic Wind Turbine Generator Design



Source: COP Volume I, Section 4.2.1; Epsilon 2022a
ft = feet; m = meter; m^2 = square meter; MLLW = mean lower low water; SWDA = Southern Wind Development Area; WTG = wind turbine generator

Figure 2.1-6: Phase 1 Monopile Foundation Conceptual Drawing



Source: COP Volume I, Section 4.2.1; Epsilon 2022a
ft = feet; m = meter; m^2 = square meter; MLLW = mean lower low water; SWDA = Southern Wind Development Area; WTG = wind turbine generator

Figure 2.1-7: Phase 1 Jacket Foundation Conceptual Drawing

The ESPs could be co-located with WTG positions. In such cases, two foundations would be installed in a single position, separated by approximately 500 feet (COP Volume I, Section 3.2.1.3; Epsilon 2022a). As a result, Phase 1 could include 63 foundations at 62 positions, and Alternative B overall would include up to 132 foundations in the 130 positions shown on Figure 2.1-3. Each ESP would contain up to approximately 118,281 gallons of transformer oil, approximately 335 gallons of general oil, and approximately 5,468 gallons of diesel fuel. The COP provides additional details related to proposed chemicals stored in WTGs and ESPs, as well as their anticipated volumes (Volume I, Section 3.3.4.4 and Table 4.3-7; Epsilon 2022a).

The WTGs and ESPs would include a nighttime obstruction lighting system that complies with Federal Aviation Administration (FAA) and U.S. Coast Guard (USCG) lighting standards and is consistent with BOEM best practices (BOEM 2021a). The applicant's lighting and marking plan would describe the lighting and marking system as part of the final layout plan, consistent with USCG standards. Such a plan would specify WTG paint colors and the lighting configuration, and BOEM would require the applicant to include justification for any deviations from BOEM's usual guidelines on lighting and marking. The applicant anticipates using (and BOEM may require, as a condition of COP approval outlined in the ROD) an aircraft detection lighting system (ADLS) that would automatically activate lights when aircraft approach. The WTGs would be painted off-white or light grey (no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey) to reduce daytime visibility against the horizon.

The applicant would submit an application to USCG for a Private Aids to Navigation (PATON) permit for each WTG constructed. Upon receipt and review of this application, which has not yet been filed, USCG would issue the PATON permits. Each WTG would be maintained as a PATON and contain marine navigation lighting and marking in accordance with the USCG's PATON marking guidance for offshore wind facilities in waters of the USCG First District (which includes waters from northern New Jersey to the Maine-Canada border [USCG 2022]). All WTGs and ESPs would also display a uniform system of marine navigation lighting and marking that includes yellow flashing lights on every WTG foundation and alphanumeric identifiers (approximately 10 feet high) on each WTG tower and/or foundation. The lights and alphanumeric identifiers would be visible from all directions. Each WTG's air draft restriction would be indicated on the foundation and/or tower. The proposed Project also includes mariner radio activated sound signals[6] and automatic identification system (AIS) transponders for offshore facilities.

The WTGs would be installed using jack-up vessels, anchored vessels, or dynamic positioning (DP)[7] vessels along with necessary support vessels and supply vessels. Vessels would be equipped with a crane and a pile-driving hammer. The applicant would begin pile driving by using a "soft start" to help enable some marine life to leave the area before driving intensity increases. ESP foundation installations could require specialized crane vessels. It is possible that monopiles would be transported to the SWDA by floating in the water while pulled by tugs. The COP provides more details about installation (Volume I, Section 3.3.1; Epsilon 2022a). Scour protection for foundations would be up to 9.8 feet high, would extend away from the foundation as far as 118 feet, and would consist of rock and stone at least 2.5 inches in diameter. To maximize precision when placing scour protection, the applicant would use the fall pipe method whenever feasible, as discussed in COP Section 3.2.1.5.4 (Volume I; Epsilon 2022a).

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[6] In consultation with USCG, sound signals could include audible sound devices, such as horns, on WTGs and ESPs.

[7] DP allows a vessel to maintain its position by using a computer-controlled system that operates the propellers and thrusters.

Two high-voltage AC 220 to 275 kV offshore export cables up to 62.7 miles long (per cable) would be installed within the OECC and transmit electricity from the ESPs to a landfall site at either Craigville Public Beach or Covell's Beach in the Town of Barnstable. One or more fiber optic cables (for communication and other purposes) would also be installed within the OECC. The offshore export cables would be installed at a target burial depth of 5 to 8 feet below the seafloor.

As part of the PDE, several cable installation methods could be used for the inter-array cables, inter-link cables, and offshore export cables. The applicant would typically use post-lay burial techniques for cables, which involve laying cable sections on the seafloor and using a jet plow or jet trenching (or possibly a mechanical plow) to bury the cables. Other burial methods could be more rarely used, although the choice of installation method would depend on seafloor conditions and sediment characteristics (COP Volume I, Section 3.3.1.3; Epsilon 2022a). The applicant states that installation method selection would prioritize adequate burial depth achievement while using the "least environmentally impactful [method] that is practicable for each segment of cable installation" (COP Volume I, Section 3.3.1.3.6; Epsilon 2022a). If sufficient burial is not achieved on the first installation pass, the applicant would make subsequent attempts, possibly using other installation techniques to achieve sufficient burial. No drilling or blasting would be required.

Prior to cable laying, a pre-lay grapnel run and pre-lay survey would be performed to clear obstructions and inspect the route. Large boulders along the route may need to be relocated, and some dredging may be required prior to cable laying to achieve sufficient burial depth below the stable sea bottom. Most of the dredging would occur on large sand waves, which are mobile features (COP Volume II-A, Figure 3.2-3; Epsilon 2022a). The applicant anticipates that, where necessary, dredging would occur within a corridor that is 50 feet wide at the bottom and 1.6 feet deep, potentially extending as deep as 17 feet.

For the installation of the two Phase 1 offshore export cables, total dredging could affect up to 52 acres and include up to 176,300 cubic yards of dredged material. The applicant could use several techniques to accomplish the dredging but would primarily rely on either trailing suction hopper dredge (TSHD) or jetting (also known as mass flow excavation).[8] For Phase 1, a TSHD would be used to remove enough of the top of a sand wave (to be deposited into a hopper) to allow subsequent cable installation into the stable seabed using one of the techniques described above. Should a TSHD be used, the TSHD would dredge along the cable alignment until the hopper was filled to an appropriate capacity, at which point the TSHD vessel would sail several hundred feet away and deposit the dredged material within the OECC.

Jetting uses a pressurized stream of water to push sand to the side. The jetting tool draws in seawater from the sides and jets this water out from a vertical down pipe at a specified pressure and volume. The down pipe is positioned over the cable alignment, enabling the stream of water to fluidize the sands around the cable, allowing the cable to settle into the trench. This process causes the top layer of sand to be side-casted to either side of the trench; jetting removes the top of the sand wave and buries the cable. Typically, several passes are required to lower the cable to the minimum target burial depth. Protection conduits installed at the approach leading to each WTG and ESP foundation protect all offshore export cables and inter-array cables.

If sufficient burial depth is not achieved through the methods described above, additional cable protection measures such as rock placement, gabion rock bags, concrete mattresses, half-shell pipes, or similar

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[8] The TSHD is used in sand waves of most sizes, whereas the jetting technique is used in sand waves less than 6.6 feet high. Sand wave dredging could be accomplished entirely by the TSHD or by a combination of jetting and TSHD.

techniques could be needed. Rock placement involves laying rocks on top of the cable to provide protection. Concrete mattresses are prefabricated flexible concrete coverings that are laid on top of the cable. In certain cases, the mattresses can be filled with grout or sand (referred to as grout/sandbags); this method is generally applied on smaller-scale applications rather than standard concrete mattresses. Lastly, half-shell pipes or similar products could be used that are made from composite materials or cast iron with suitable corrosion protection. The applicant estimates that approximately 7 percent of the OECC route and 2 percent of inter-array and inter-link cable length could require such additional measures (COP Volume I, Section 3.2.1; Epsilon 2022a). The potential impacts associated with implementation of the cable protection methods specified above are described in Chapter 3.

Site preparation would include high-resolution geophysical (HRG) surveys and other risk mitigation for potential unexploded ordnance, munitions, and explosives of concern. Avoidance is the preferred approach to ordinance and munitions; however, where avoidance is not possible, proper disposal of the contaminated object would occur with appropriate contractors involved (COP Volume II-A, Section 3.2.6.4; Epsilon 2022a). The applicant would use vessels, vehicles, and aircraft during Phase 1 construction, including construction and support vessels to complete tasks in the SWDA and along the OECC. Table 2.1-4 lists the onshore port facilities that could be used for crew transfer, components shipments, storage, preparing components for installation, and potentially some component fabrication and assembly. In addition to the ports listed in Table 2.1-4, some components, materials, and vessels could come from ports in other nations.

The applicant does not propose to direct or implement any potential port improvements specifically to support Phase 1. In selecting the ports to be used for Phase 1 construction and operations, the applicant would consider the suitability of existing ports listed in Table 2.1-4, including upgrades planned or completed by the port owners. Therefore, no port upgrades would occur as a direct result of Phase 1 (COP Volume I, Section 3.2.2.5; Epsilon 2022a).

Table 2.1-4: Possible Ports Used during Phase 1 Construction, Operations, and Decommissioning

Geography	Ports
Massachusetts	New Bedford Marine Commerce Terminal, other areas in New Bedford Harbor, Brayton Point Commerce Center, Vineyard Haven, Fall River, Salem
Rhode Island	Port of Davisville, ProvPort, South Quay Terminal
Connecticut	Bridgeport, New London State Pier
New York	Capital Region Ports (Port of Albany, Coeymans, and New York State Offshore Wind Port); Staten Island Ports (Arthur Kill and Homeport Pier); South Brooklyn Marine Terminal; GMD Shipyard; Shoreham; Greenport Harbor (operations only)
New Jersey	Paulsboro
Canada	Halifax, Sheet Harbor, Saint John

ProvPort = Port of Providence

During Phase 1 construction, the applicant anticipates an average of approximately 30 vessels operating during a typical workday in the SWDA and along the OECC. Approximately 60 vessels could be present during the period of maximum construction activity at the start of WTG installation. Many construction vessels would remain in the SWDA or OECC for days or weeks at a time. The proposed Project construction would generate an average of 7 daily round trips from select ports listed in Table 2.1-4, with approximately 15 daily round trips during maximum construction activity. Additionally, construction vessels may make infrequent trips to port for bunkering and provisioning.

The maximum number of vessels at any one time is highly dependent on the proposed Project's final schedule, final design, and the logistics solution used to achieve compliance with the Jones Act (COP Volume I, Section 3.3.1.12.1; Epsilon 2022a). Vessel types proposed for the cable installation include vessels capable of DP, anchored vessels, self-propelled vessels, and/or barges. All proposed Project vessels are subject to applicable USCG regulations for ballast water management (33 CFR Part 151 Subpart C, 33 CFR Part 151 Subpart D, and 46 CFR Subpart 162.060). These requirements apply to all U.S. and foreign-flagged commercial vessels equipped with ballast water tanks and operating in U.S. waters. Additional information can be found in the Navigation and Vessel Inspection Circular 01-18, Ballast Water Management for Control of Non-Indigenous Species in Waters of the United States (USCG 2018).

The proposed Project could require vessel anchoring, especially during the cable burial process. Anchoring, if used, would avoid sensitive seafloor habitats to the greatest extent practicable and be completely prohibited in eelgrass beds (Appendix H). Where it is considered impracticable to avoid a sensitive seafloor habitat, mid-line anchor buoys would be used where feasible and considered safe by vessel operators as a potential measure to reduce and minimize potential impacts from anchor line sweep (Appendix H).

Phase 1 Operations and Maintenance

Phase 1 is expected to have an operating period of 30 years. The proposed Project would include a comprehensive maintenance program, including preventative maintenance (e.g., oil changes) based on statutory requirements, original equipment manufacturer (OEM) guidelines, and industry best practices. In addition, the applicant would maintain an oil spill response plan (OSRP), an emergency response plan, and a safety management system, including an environmental management system that would be issued to the vessels and construction firms (COP Volume I, Appendices I-B and I-F; Epsilon 2022a). These BOEM- and Bureau of Safety and Environmental Enforcement- (BSEE-) approved plans would be in place prior to construction. The applicant would inspect WTGs, foundations, ESPs, inter-array cables, offshore export cables, landfall locations, onshore export cables, and other parts of the proposed Project.

Proposed Project WTGs would be designed to operate without attendance by any operators. Continuous monitoring would be conducted using a supervisory control and data acquisition (SCADA) system from a remote location. Parameters that would be monitored include temperature limits, vibration limits, current limits, voltage, etc. The WTGs would include self-protection systems that would be activated if a WTG operates outside its specifications or the SCADA system fails. These self-protection systems could curtail or halt WTG production or disconnect WTGs from the grid.

The applicant and/or the selected WTG OEM would be responsible for the operation and monitoring of the WTGs 24 hours per day, 7 days per week (24/7). This would be achieved through the applicant's operations facilities and a 24/7 control center owned and operated by shareholder company Avangrid Renewables, LLC.

Onshore Activities and Facilities

For Phase 1, the applicant would establish a long-term service operation vessel (SOV) operations base in Bridgeport, Connecticut, and operate crew transfer vessels (CTV) or the SOV daughter craft out of Vineyard Haven on Martha's Vineyard. Although the applicant plans to locate the Phase 1 operations facilities in Bridgeport and/or Vineyard Haven, other ports listed in Table 2.1-4 could also be used to support operations activities.

The onshore substation site, onshore export cables, and splice vaults would require minimal maintenance. The applicant would conduct inspections and repairs according to industry standards for land-based power transmission facilities.

Offshore Activities and Facilities

Routine maintenance is expected for WTGs, ESPs, and foundations. The applicant expects to conduct annual inspections of foundations, structures, components, and equipment, including, but not limited to, high-voltage equipment, lifting equipment, safety equipment, hook-on points, ladders, boat landing structures, and internal structures (e.g., corrosion measurement, etc.). The applicant would proactively repair or replace deteriorated components identified during these inspections. The applicant would conduct HRG surveys and monitor cable exposure and/or depth of burial. It is expected that the cables will be surveyed within 6 months of commissioning, at years 1 and 2, and every 3 years thereafter.

The applicant would prepare detailed preventative maintenance plans as part of the permitting process to identify specific timetables for other inspections and maintenance activities. This monitoring schedule may be adjusted over time based on results of the ongoing surveys (COP Volume I, Section 3.2.3.3; Epsilon 2022a). The applicant would need to use vessels, remote sensing equipment, vehicles, and aircraft during the inspection and maintenance activities described above.

Phase 1 Conceptual Decommissioning

According to 30 CFR Part 585 and other BOEM requirements, the applicant would be required to remove or decommission all installations and clear the seabed of all obstructions created by the proposed Project. All foundations would need to be removed to a depth of 15 feet below the mudline (30 CFR § 585.910(a)). The applicant would be required to complete decommissioning within 2 years of termination of the lease and either reuse, recycle, or responsibly dispose of all removed materials. The applicant has submitted a decommissioning plan as part of the COP (Volume 1, Section 3.3.3.4), and the final plan would outline the applicant's process for managing waste and recycling proposed Project components (Volume I; Epsilon 2022a). Although the proposed Project has a designed life span of 30 years, some installations and components could remain fit for continued service after this time. The applicant would need to apply for an extension to operate the proposed Project for more than the 30-year operations term stated in its lease.

BOEM requires the applicant to submit a decommissioning application upon the earliest of the following dates: 2 years before the expiration of the lease; 90 days after completion of the commercial activities on the commercial lease; or 90 days after cancellation, relinquishment, or other termination of the lease (30 CFR § 585.905). Upon completion of the technical and environmental reviews, BOEM can approve, approve with conditions, or disapprove the lessee's decommissioning application. This process includes an opportunity for public comment and consultation with municipal, state, and federal management agencies. Furthermore, pursuant to 30 CFR Part 585 and other BOEM requirements, the applicant would be required to remove or decommission all installations and clear the seabed of all obstructions created by the proposed Project. The applicant would need to obtain separate and subsequent approval from BOEM to leave any portion of the proposed Project in place in compliance with all applicable law.

According to the decommissioning plan included in the COP (Volume I, Section 3.3.3.4; Epsilon 2022a), the WTG and ESP fluids would be drained into vessels for disposal in onshore facilities before disassembling the structures and bringing them to port. Foundations would be temporarily emptied of sediment, cut 15 feet below the mudline in accordance with BOEM regulations (30 CFR § 585.910(a)), and removed. The portion of foundations buried below 15 feet would remain, and the depression refilled with the temporarily removed sediment. In consideration of mobile gear fisheries (i.e., dredge and bottom trawl gear), the applicant would remove scour protection during decommissioning. Offshore cables could be retired in place or removed, subject to 30 CFR § 585.900 (COP Volume I, Section 3.3.3.4; Epsilon 2022a).

Depending on the needs of the host locations, the applicant may leave onshore facilities in place for future use. Onshore cable removal, if required, would likely proceed using truck-mounted winches and handling equipment. There are no plans to disrupt streets or onshore public utility ROWs by excavating or deconstructing buried facilities. If the COP is approved or approved with modifications, the applicant would be required to submit a bond (or another form of financial assurance) held by the U.S. government to cover the cost of decommissioning the entire facility in the event that the applicant would not otherwise be able to decommission the facility.

2.1.2.3 Phase 2 (Commonwealth Wind Project)

Phase 2, also known as the Commonwealth Wind Project, would be developed immediately southwest of Phase 1 in the portion of Lease Area OCS-A 0534 that is not developed as part of Phase 1. Phase 2 would deliver at least 1,232 MW of power to the ISO New England grid to meet the applicant’s long-term contractual obligations with Massachusetts electric distribution companies. Phase 2 would consist of up to 88 WTGs and 3 ESPs (Table C-3 in Appendix C). The full buildout and capacity of Phase 2 is largely dependent on market conditions and available WTG technology at the time of procurement. The applicant has identified six potential scenarios, including contingencies, for the Phase 2 OECC (Table 2.1-2). The applicant’s preference is to install the Phase 2 OECC adjacent to the Phase 1 OECC. The Phase 2 OECR is proposed to be installed in the same general part of the Town of Barnstable (although following different routes) as the Phase 1 OECR (Figure 2.1-8).

If the applicant is unable to install all Phase 2 export cables in the proposed (Eastern Muskeget) OECC through Muskeget Channel, one or more Phase 2 cables could be installed in the Western Muskeget Variant. If technical, logistical, grid interconnection, or other unforeseen issues prevent all Phase 2 export cables from interconnecting at the West Barnstable Substation, the applicant would develop and use the South Coast Variant (SCV) in place of or in addition to the currently proposed Phase 2 OECC and OECR (Figure 2.1.9 shows the OECCs for the Western Muskeget Variant and SCV). Because the SCV is a contingency, the applicant had not provided information on grid interconnection routes, onshore cable routes, landfall locations, and nearshore cable routes necessary to prepare a sufficient analysis of the SCV at the time of publication of this Draft EIS. Therefore, the analysis of the SCV in this Draft EIS includes available information but reflects some uncertainty. If the applicant determines that the SCV is necessary, the applicant would be required to file a COP revision per 30 CFR § 585.634, describing the need for the SCV and providing the information necessary to complete a sufficient analysis. In response, BOEM would complete additional environmental analysis and relevant consultations required by NEPA, NHPA, and other applicable statutes (including making the analysis available for public review and comment) to inform BOEM’s decision to approve, approve with conditions, or disapprove the COP revision.

Phase 2 Construction and Installation

Phase 2 includes the construction of both onshore and offshore facilities. If Phase 2 proceeds immediately following Phase 1, Phase 2 onshore construction would likely begin in 2024, and offshore construction would begin in late 2025 (COP Volume I, Section 4.1.1.3; Epsilon 2022a). In this scenario, each major construction activity would be sequential for the two phases (e.g., Phase 2 foundation installation would immediately follow Phase 1 foundation installation). However, there could be some overlap of Phase 1 and Phase 2 offshore activities (e.g., Phase 2 foundation installation could occur at the same time as Phase 1 WTG installation). There would be no concurrent/simultaneous pile driving of Phase 1 and Phase 2 foundations. Phase 2 construction could also begin later than 2025, depending on market conditions (COP Volume I, Section 4.1.1.3; Epsilon 2022a). It is expected that Phase 2 would follow a similar order of construction and timing of activities as Phase 1.

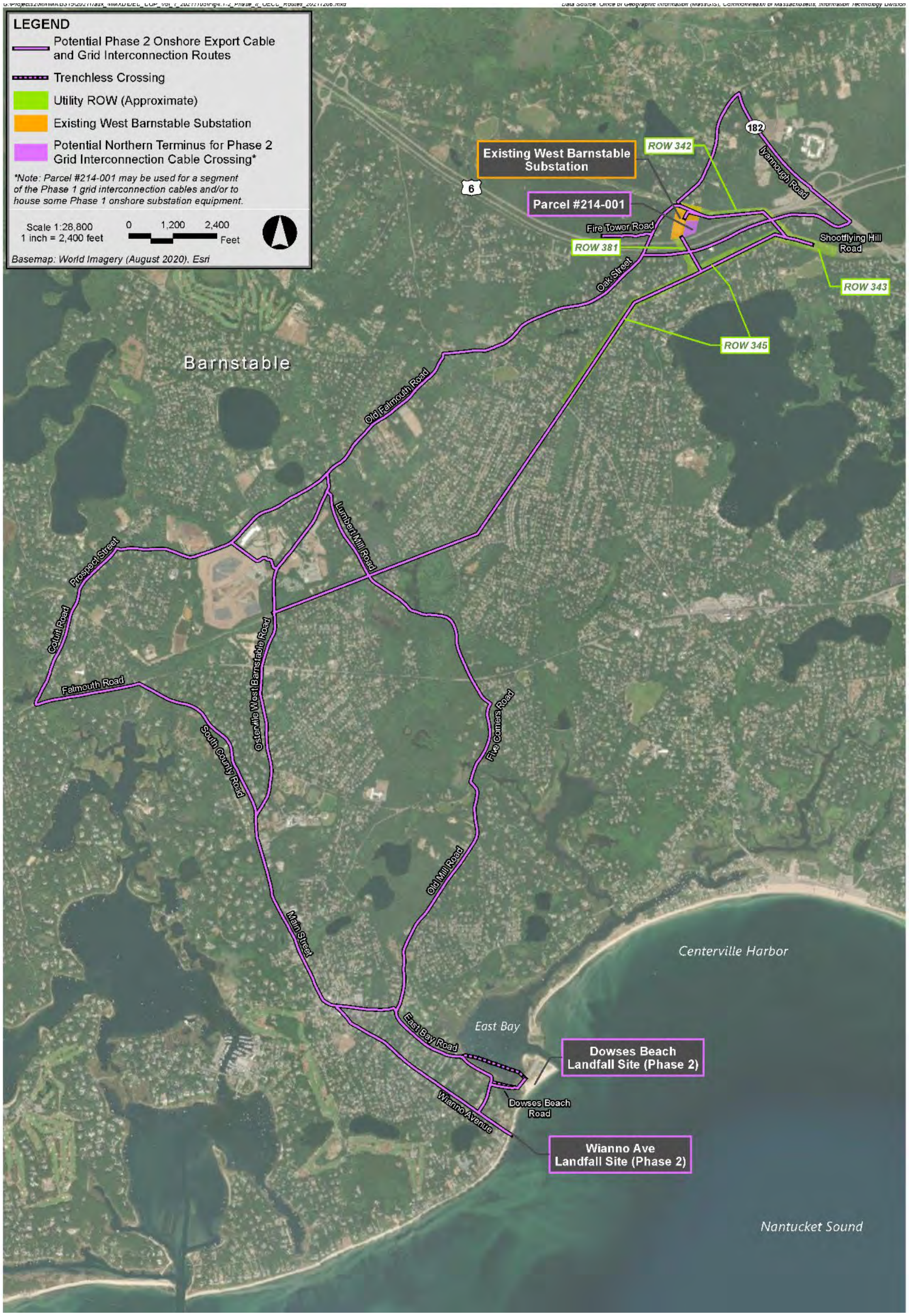
Onshore Activities and Facilities

The applicant intends to interconnect the entire Phase 2 electrical output to the electrical grid at the West Barnstable Substation, the same location as used for Phase 1. The final design of Phase 2 (including the number and size of the WTGs and the total power production capacity of Phase 2) would depend on the available capacity at existing onshore grid tie-in points and could require up to two onshore transmission systems. Consistent with the PDE approach, this Draft EIS evaluates a Phase 2 configuration with two landfall sites, two OECRs, and two onshore substation sites to transmit power to the grid. The first system would be within the Town of Barnstable, while the second system, if necessary, would include the SCV and constructed in south-central Bristol County, Massachusetts. Figure 2.1-8 shows the location of the potential onshore transmission systems in Barnstable County. The OECR and substation associated with the SCV have not been identified. BOEM will provide additional information about the SCV OECR and substation as part of a supplemental NEPA analysis once the applicant provides more detailed information. As a result, this chapter does not further discuss the SCV OECR or substation(s).

The Phase 2 offshore export cables would make landfall within paved parking areas at either the Dowses Beach Landfall Site or the Wianno Avenue Landfall Site in the Town of Barnstable (Figure 2.1-8). The ocean-to-land transition at the Dowses Beach Landfall Site would employ the HDD technique, which would avoid or minimize impacts on the beach, intertidal zone, and nearshore areas. The preferred transition method at the Wianno Avenue Landfall Site would also be HDD, although open trenching methods may be used at this site due to challenges associated with topography and other existing conditions (COP Volume I, Section 4.2.2.1; Epsilon 2022a).

The applicant would construct one splice vault (described in Section 2.1.2.2) per offshore export cable at the landfall site. These would be accessible after construction via a manhole. Inside the splice vault, the 220 to 345 kV AC offshore export cables would be connected to the 345 kV onshore export cables. From the landfall site, the Phase 2 OECR would be approximately 10.6 miles long, depending on the cable landfall site and route variant selected. The route options and variants are shown on Figure 2.1-8 (COP Volume I, Section 4.2.2.2; Epsilon 2022a). Onshore export cables would be installed in duct banks as described for Phase 1 (Section 2.1.2.1). Duct banks would primarily be installed via open trenching within public roadway layouts (either beneath the road or within 10 feet of the pavement), although portions of the duct bank could be within existing utility ROWs. Modification to the West Barnstable Substation or to parcels at 6 or 8 Shootflying Hill Road and Parcel #214-001, if necessary, would likely be as described for Phase 1 (COP Volume I, Section 4.2.2; Epsilon 2022a).

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



ROW = right-of-way

Figure 2.1-8: Proposed Phase 2 Onshore Elements

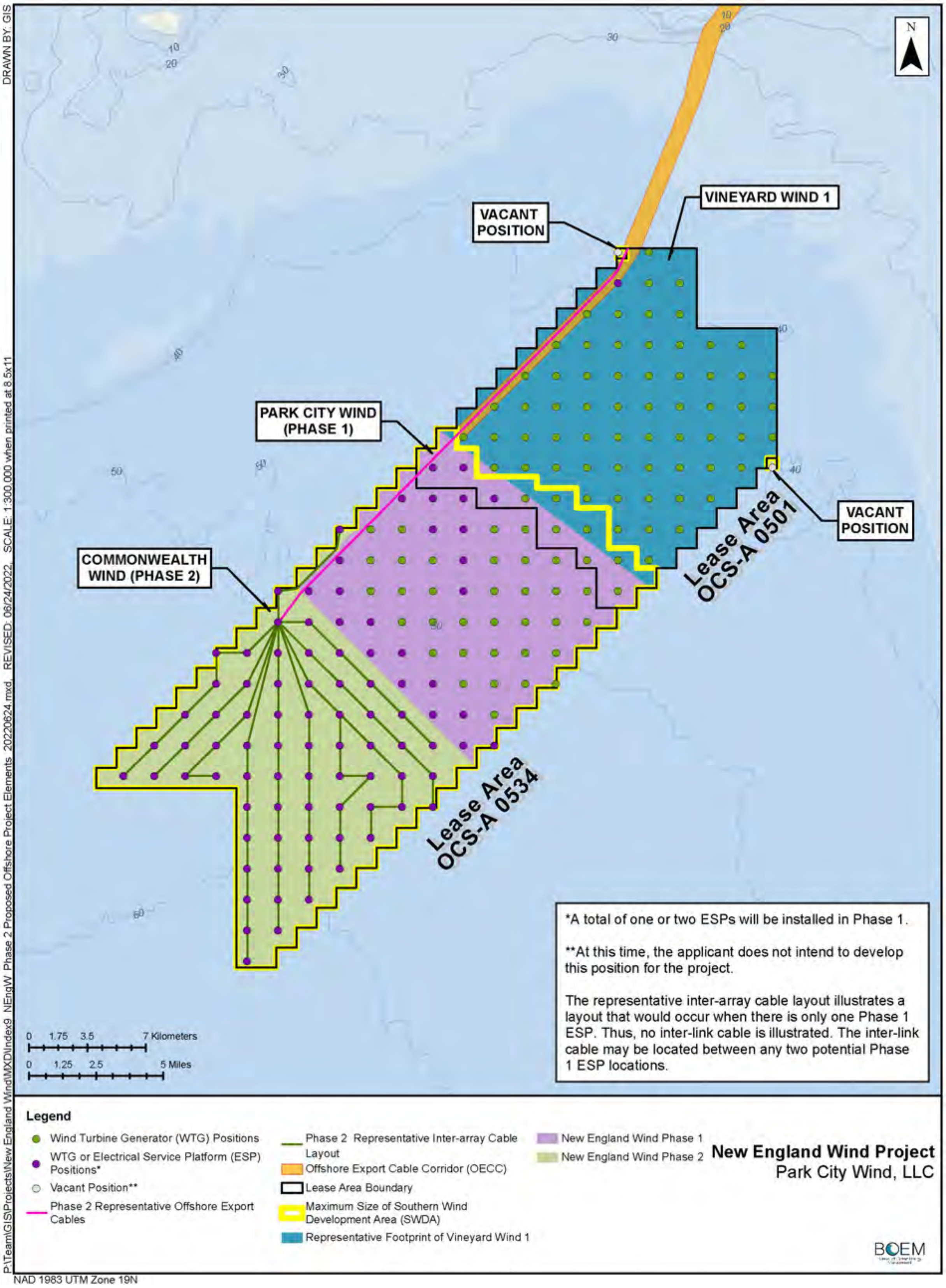
Offshore Activities and Facilities

Offshore proposed Project components for Phase 2 include similar components as those described for Phase 1 (Figure 2.1-9). The offshore proposed Project elements are within federal waters, with the exception of a portion of the export cables within state waters. The COP provides a detailed description of proposed construction methods (Volume I, Section 4.3.1; Epsilon 2022). The Phase 2 WTGs and ESPs would have the same maximum dimensions as the Phase 1 WTGs and ESPs (Table C-3 in Appendix C) and would be mounted on either monopile, jacket, or bottom-frame foundations. Monopiles for Phase 2 WTGs and ESPs would be as described in Section 2.1.2.2 for Phase 1. Phase 2 jacket foundations could be installed either with pin piles (as described for the Phase 1 WTGs and ESPs) or suction buckets. If suction buckets are used, there would be four buckets to penetrate the seafloor bottom up to 49 feet (Figure 2.1-10). A bottom-frame foundation has a triangular spaceframe type structure secured to the seafloor, which could use either pin piles or suction buckets (Figures 2.1-11 and 2.1-12). If pin piles are used, there would be three piles driven up to 279 feet into the seabed and suction buckets to penetrate up to 49 feet into the seabed. Additional schematic drawings and photos of the proposed foundation types are included in the COP (Volume I, Section 4.2.1; Epsilon 2022). The amount of oil and other chemicals in each Phase 2 WTG would be the same as described for the Phase 1 WTGs (Section 2.1.2.2).

The applicant would construct up to three ESPs in the SWDA to serve as the interconnection point between the WTGs and the export cables. If two or three ESPs are used for Phase 2, each ESP could occupy one of the 130 positions in the SWDA, or two of the ESPs could be co-located at a single position (COP Volume I, Section 4.2.1.3; Epsilon 2022). Phase 2 could thus include 89 foundations at 88 positions.[2] The Phase 2 ESPs would be along the northwestern edge of the SWDA and as described for Phase 1 (Section 2.1.2.2). As with Phase 1, a string of multiple WTGs would be connected to each inter-array cable, and the inter-array cables would be connected to the ESP buried below the seabed. The number and orientation of the inter-array cables would depend on the exact WTG and ESP positions used. A 66 to 345 kV inter-link cable would be installed to connect the ESPs together. As described in Section 2.1.2.2, ESPs could be co-located with WTG positions. Overall, Alternative B would include up to 132 foundations in the 130 positions shown on Figure 2.1-3.

All WTGs and ESPs would include the same type of aviation obstruction lighting system and marine navigation components (or would adhere to applicable guidelines at the time of construction) and be painted a similar color as the Phase 1 WTGs and ESPs. As with the Phase 1 structures, the applicant would apply to have each Phase 2 structure registered as a PATON.

The installation methodology for Phase 2 structures would be as described for Phase 1, including the use of jack-up, anchored, or DP vessels. Scour protection for foundations would be as described for Phase 1 (Section 2.1.2.2). To transmit electricity to shore, the applicant would install two to three, 220 to 345 kV high-voltage AC offshore export cables. Depending on the exact landfall location selected and the final location of the Phase 2 ESPs, the proposed Phase 2 OECC route would have a maximum total length of 226 miles between the SWDA and the landfall site in Barnstable. The proposed Phase 2 OECC, Western Muskeget Variant, and the SCV are shown on Figure 2.1-13. One or more fiber optic cables (for communication and other purposes) would also be installed within the OECC.

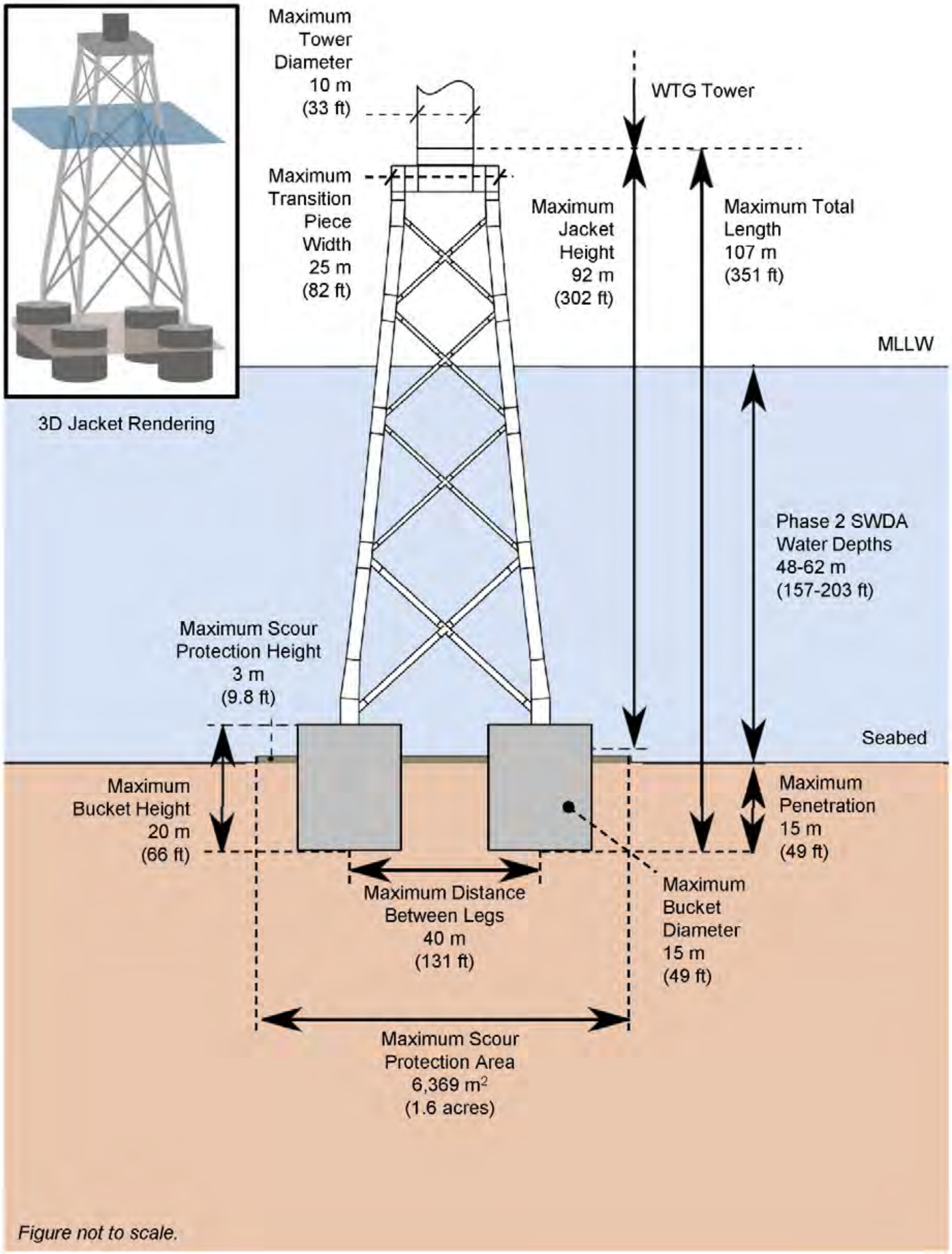


*A total of one or two ESPs will be installed in Phase 1.

**At this time, the applicant does not intend to develop this position for the project.

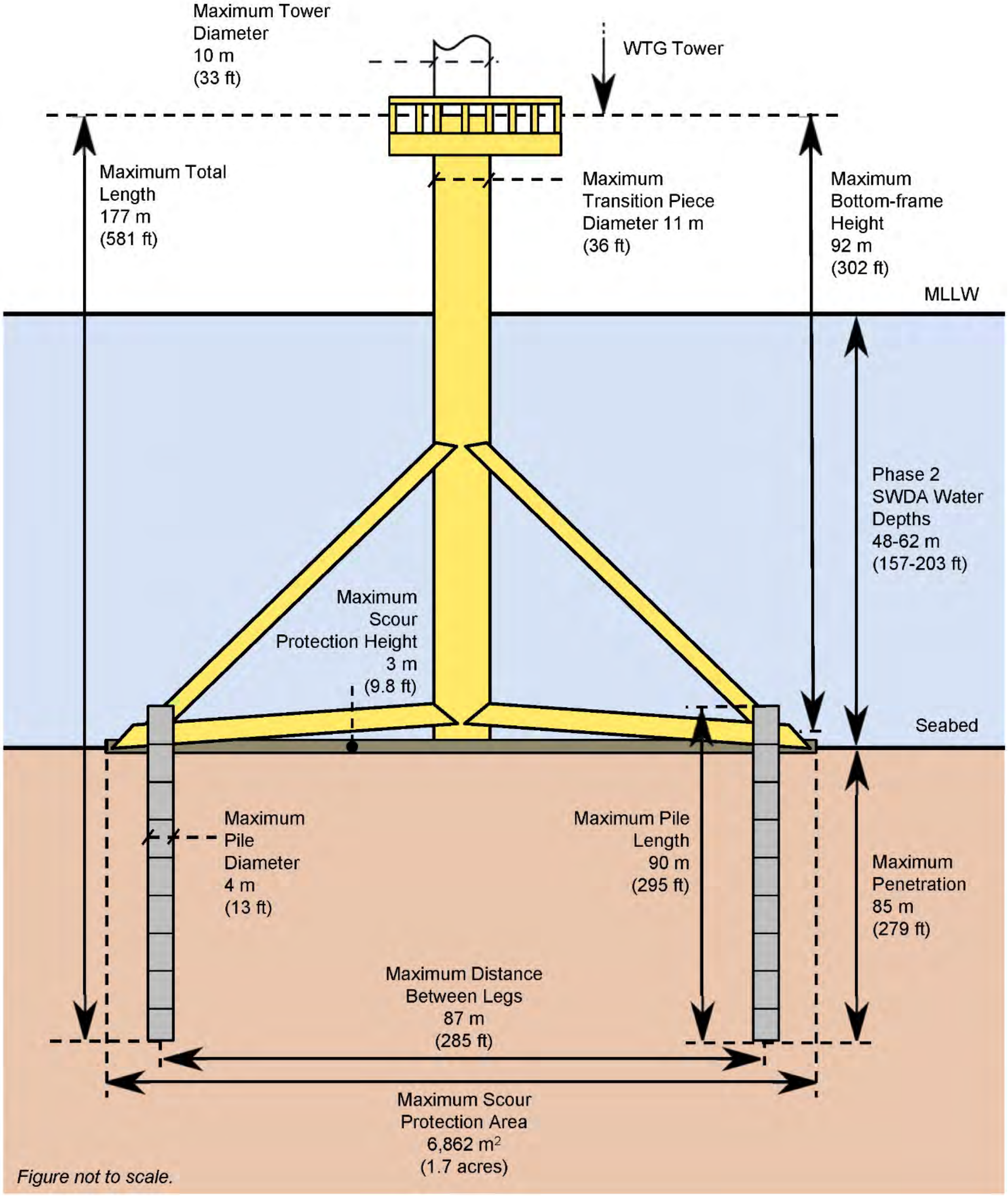
The representative inter-array cable layout illustrates a layout that would occur when there is only one Phase 1 ESP. Thus, no inter-link cable is illustrated. The inter-link cable may be located between any two potential Phase 1 ESP locations.

Figure 2.1-9: Proposed Phase 2 Offshore Elements



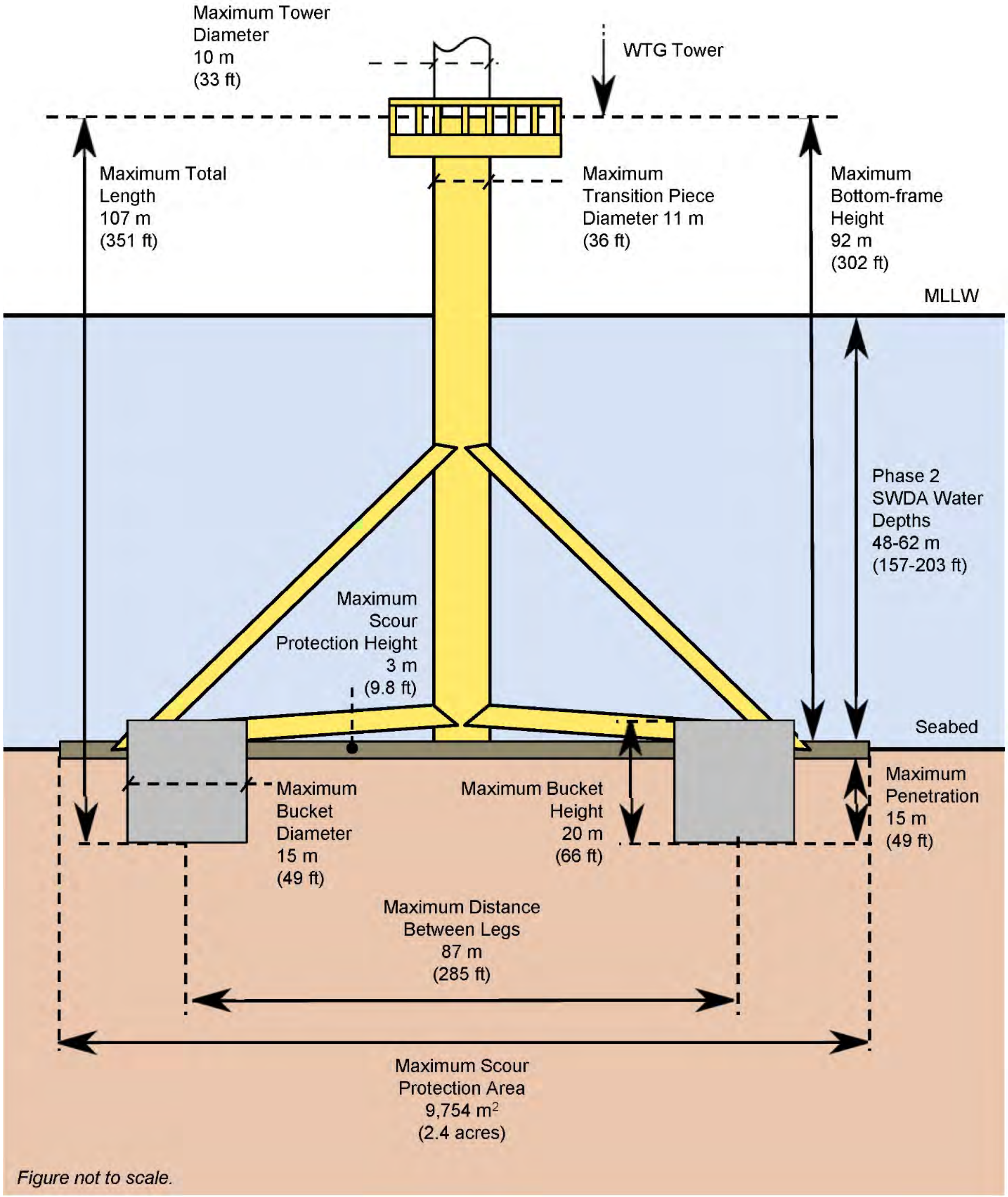
Source: COP Volume I, Section 4.2.1; Epsilon 2022
ft = feet; m = meter; m^2 = square meter; MLLW = mean lower low water; SWDA = Southern Wind Development Area; WTG = wind turbine generator

Figure 2.1-10: Phase 2 Jacket Foundation with Suction Buckets Conceptual Drawing



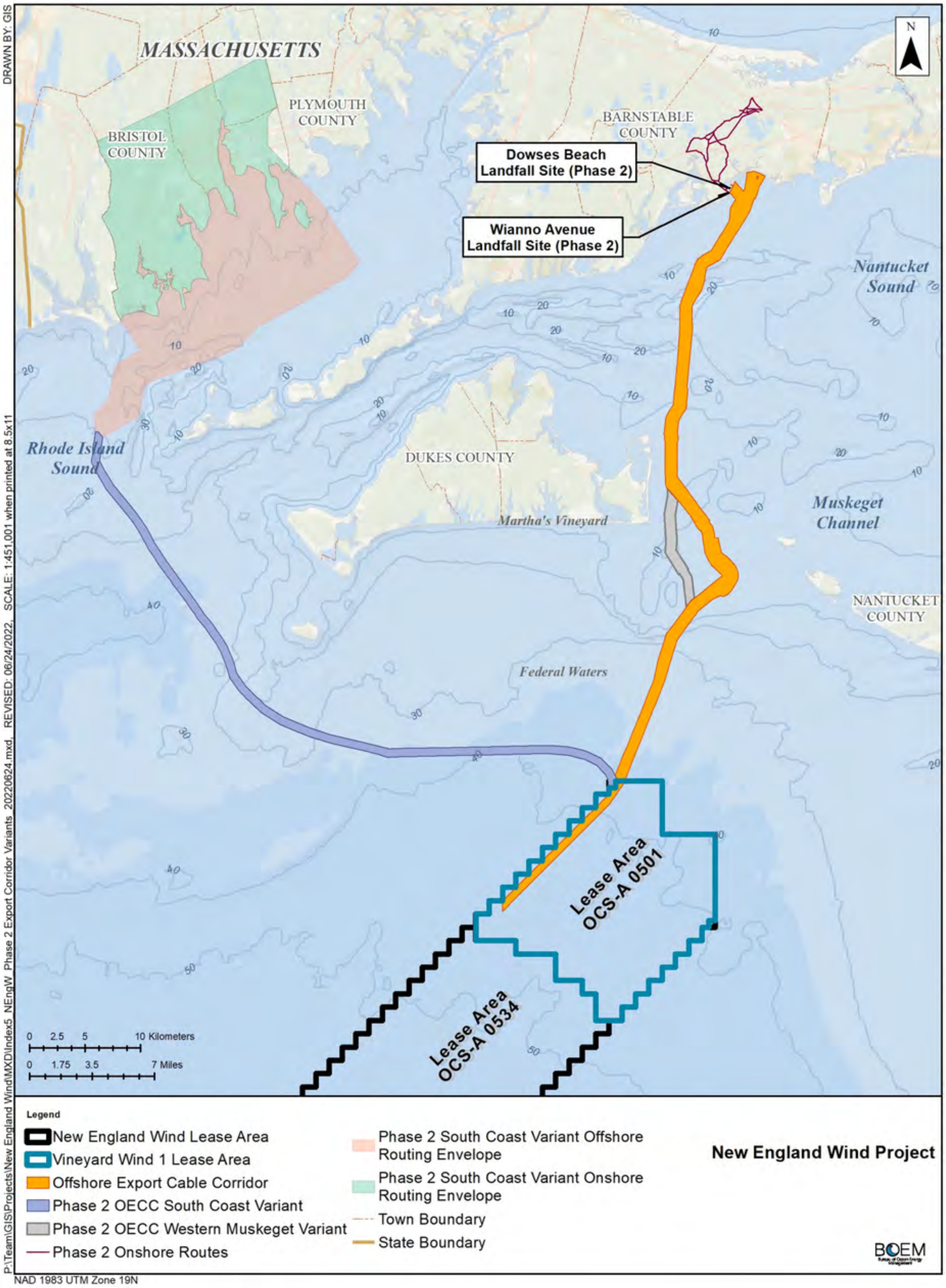
Source: COP Volume I, Section 4.2.1; Epsilon 2022
ft = feet; m = meter; m^2 = square meter; MLLW = mean lower low water; SWDA = Southern Wind Development Area; WTG = wind turbine generator

Figure 2.1-11: Phase 2 Bottom-Frame Foundation with Pin Piles Conceptual Drawing



Source: COP Volume I, Section 4.2.1; Epsilon 2022
ft = feet; m = meter; m^2 = square meter; MLLW = mean lower low water; SWDA = Southern Wind Development Area; WTG = wind turbine generator

Figure 2.1-12: Phase 2 Bottom-Frame Foundation with Suction Buckets Conceptual Drawing



OECC = offshore export cable corridor

Figure 2.1-13: Proposed Phase 2 Variants

The Phase 2 offshore export cables would be installed at a target burial depth of 5 to 8 feet below the seafloor. Installation techniques for the Phase 2 offshore export cables would be as described for the Phase 1 cables (Section 2.1.2.2). For the installation of three Phase 2 offshore export cables within the proposed corridor through Muskeget Channel to landfalls in Barnstable, total dredging could impact up to 67 acres and include up to 235,400 cubic yards of dredged material.

If selected, the portion of the SCV within federal waters would be approximately 78.3 miles long per export cable. Dredging for installation of two export cables in the SCV would affect 3.3 acres and include up to 6,131 cubic yards of dredged material for the federal waters portion of the two export cables (Epsilon 2022). These impacted areas would be in addition to or in place of some or all of the impacts described for the proposed OECC through Muskeget Channel, depending on the number of Phase 2 cables installed in the proposed OECC and SCV OECC. Installation of a third export cable within the SCV would require additional dredging. BOEM will provide additional information about the SCV, including any potential dredging within state waters, as part of a supplemental NEPA analysis once the applicant provides more detailed information. If the SCV is selected, a portion or all of the dredging impacts for the Muskeget Channel routes would not occur.

The applicant would use vessels, vehicles, and aircraft during Phase 2 construction, including both construction and support vessels to complete tasks in the SWDA and along the OECC. The possible ports used for Phase 1 construction, as listed in Table 2.1-4, would also be potentially used for Phase 2 crew transfer, components shipments, storage, preparing components for installation, and potentially some component fabrication and assembly. In addition, some components, materials, and vessels could come from ports in other nations.

The applicant does not propose to direct or implement any potential port improvements specifically to support Phase 2. In selecting the ports to be used for Phase 1 construction and operations, the applicant would consider the suitability of existing ports listed in Table 2.1-4, including upgrades planned or completed by the port owners. Therefore, no port upgrades would occur as a direct result of Phase 2 (COP Volume I, Section 4.2.2.5; Epsilon 2022).

During Phase 2 construction, the applicant anticipates an average of approximately 30 vessels operating during a typical workday in the SWDA and along the OECC. Approximately 60 vessels could be present during the period of maximum construction activity at the start of WTG installation. The applicant has noted that many construction vessels would remain in the SWDA or OECC for days or weeks at a time. The proposed Project construction would generate an average of 8 daily round trips from select ports listed in Table 2.1-4, with approximately 15 daily round during maximum construction activity. Additionally, construction vessels may make infrequent trips to port for bunkering and provisioning.

As with Phase 1, the maximum number of vessels involved in the proposed Project at any one time is highly dependent on the proposed Project’s final schedule, final design, and the logistics solution used to achieve compliance with the Jones Act (COP Volume I, Section 4.3.1.12.1; Epsilon 2022). Vessel types proposed for Phase 2 would be similar to and subject to the same regulations as those described for Phase 1 in Section 2.1.2.2. Depending on the proposed Project’s final schedule, some vessel trips could serve both Phase 1 and Phase 2 construction activities.

The proposed Project could require anchoring of vessels, especially during the cable burial process. Anchoring, if used, would avoid sensitive seafloor habitats to the greatest extent practicable and be completely prohibited in eelgrass beds (Appendix H). Where it is considered impracticable to avoid a sensitive seafloor habitat, mid-line anchor buoys would be used, where feasible and considered safe by vessel operators, as a potential measure to reduce and minimize potential impacts from anchor line sweep (Appendix H).

Phase 2 Operations and Maintenance

Phase 2 is expected to have an operating period of 30 years and be subject to the comprehensive maintenance program and management plans identified in Section 2.1.2.2 (COP Appendices I-B and I-F; Epsilon 2022). As with Phase 1, Phase 2 WTGs would be designed to operate without attendance by any operators, and continuous monitoring would be conducted using a SCADA system from a remote location. The Phase 2 WTGs would also include self-protection systems (as described for Phase 1 WTGs in Section 2.1.2.2) that would be activated if a WTG operates outside its specifications or if the SCADA system fails.

The applicant and/or the selected WTG OEM would be responsible for the 24/7 operation and monitoring of the WTGs. This is expected to be achieved through the applicant's operations facilities and a 24/7 control center owned and operated by shareholder company Avangrid Renewables, LLC.

Onshore Activities and Facilities

For Phase 2, the applicant would establish a long-term SOV operations base in Bridgeport, Connecticut, and would operate CTVs or the SOV daughter craft out of Vineyard Haven on Martha's Vineyard. Although the applicant plans to locate the Phase 2 operations facilities in Bridgeport and/or Vineyard Haven, other ports listed in Table 2.1-4 could also be used to support operations activities. The Phase 2 operations facilities would not necessarily be the same location as the Phase 1 operations facilities.

The onshore substation site, onshore export cables, and splice vaults would require minimal maintenance. The applicant would conduct inspections and repairs according to industry standards for land-based power transmission facilities.

Offshore Activities and Facilities

As with Phase 1, the applicant would need to use vessels, remote sensing equipment, vehicles, and aircraft during Phase 2 inspection and maintenance activities. The maintenance and inspection timeframes for Phase 2 would be similar to those described for Phase 1 (Section 2.1.2.2).

Phase 2 Conceptual Decommissioning

The decommissioning process for Phase 2 would be the same as described for Phase 1 of Alternative B (Section 2.1.2.2).

2.1.3 Alternative C – Habitat Impact Minimization Alternative

Under Alternative C, construction, operations, and decommissioning of the proposed Project's WTGs and ESPs would occur within the range of design parameters outlined in the COP, subject to applicable mitigation and monitoring measures (Appendix H). Compared to Alternative B, this alternative would minimize impacts on complex fisheries habitats—areas of seafloor that are stable, exhibit vertical relief, and/or provide rare habitat compared to the broad sand flats that characterize much of the OCS. Complex habitats include gravel or pebble-cobble beds, sand waves, biogenic structures (e.g., burrows, depressions, sessile soft-bodied invertebrates), shell aggregates, boulders, hard-bottom patches, and cobble beds, among other features (COP Volume II-A, Section 5.2; Epsilon 2022). To minimize impacts on complex fisheries habitats, BOEM would limit the potential OECC construction scenarios described in Table 2.1-2 through the implementation of one of the sub-alternatives described below.

2.1.3.1 Alternative C-1, Western Muskeget Variant Avoidance

This alternative would preclude the use of the Western Muskeget Variant, limiting available scenarios to those that include only the Eastern Muskeget route and SCV, as shown on Figure 2.1-13. Scenarios 1, 3, 5, and 6 in Table 2.1-2 would be considered under Alternative C-1. Avoiding use of the Western Muskeget Variant would avoid a crossing of a proposed OECC route for the Mayflower Wind Energy Project (Mayflower Wind) (Lease Area OCS-A 0521) within the Western Muskeget Channel. Cable crossings typically require portions of one of the cable systems (either from Mayflower Wind or the proposed Project) to be laid on the seafloor and covered with protective structures, such as half-shell pipes in lieu of burial. If the crossing occurs in complex habitat areas, the added protective structures could damage or destroy complex habitat features. By avoiding a cable crossing within the Muskeget Channel, Alternative C-1 would limit the total number of potential crossings of the Mayflower Wind cable to a single crossing south of Muskeget Channel, where complex fisheries habitat is rarer.

2.1.3.2 Alternative C-2, Eastern Muskeget Route Minimization

This alternative would minimize, to the degree practicable, the use of the Eastern Muskeget route and maximize the use of the Western Muskeget Variant and/or the SCV (Scenarios 5 and 6 in Table 2.1-2) for all Phase 2 export cables. Under this alternative, the two Phase 1 cables would be installed in the Eastern Muskeget route, along with a maximum of one Phase 2 cable. This eliminates the option for a total of two to three Phase 2 cables to be installed in the Eastern Muskeget route. This alternative could potentially reduce impacts on productive complex habitats along the Eastern Muskeget route compared to Alternative B. Scenarios 5 and 6 would require significant delays to Phase 2 due to the need to upgrade substation(s) connected to ISO-NE that are not currently planned for upgrade. Under Alternative C-2, dredging for Phase 2 cable installation could impact up to 73 acres and could include up to 274,800 cubic yards of dredged material (compared to 67 acres and 235,400 cubic yards for Alternative B and Alternative C-1).

2.2 Alternatives Considered but Not Analyzed in Detail

Under NEPA, a reasonable range of alternatives framed by the purpose and need must be developed for analysis for any major federal action. The alternatives should be “reasonable,” which the U.S. Department of the Interior has defined as those that are “technically and economically practical or feasible and meet the purpose and need of the proposed action.”[9] There should also be evidence that each alternative would avoid or substantially lessen one or more potential, specific, and significant socioeconomic or environmental impacts of the project (BOEM 2022a). Alternatives that could not be implemented if they were chosen (for legal, economic, or technical reasons), or do not resolve the need for action and fulfill the stated purpose in taking action to a large degree, are, therefore, not considered reasonable.

BOEM considered alternatives to the Proposed Action that were identified through coordination with cooperating and participating agencies, as well as public comments received during the public scoping period for the EIS. BOEM then evaluated the alternatives and dismissed from further consideration alternatives that did not meet the purpose and need, did not meet the screening criteria (described below), or both.

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[9] Per 43 CFR § 46.420(b), the terms “practical” and “feasible” are not intended to be synonymous (81 Fed. Reg. 89615 [December 12, 2016]).

An alternative was considered but not evaluated in detail if it met at least one or more of the following criteria (BOEM 2022a):

- It would not respond to BOEM's purpose and need as stated in the EIS (Section 1.2), including:
  - Resulting in activities that are prohibited under the lease, such as locating part or all of the wind energy facility outside of the lease area or constructing and operating a facility for another form of energy;
  - Not furthering the U.S. or state policies such as making OCS energy resources available for expeditious and orderly development, subject to environmental safeguards; or
  - Not meeting the applicant's primary goals, including satisfying contractual offtake agreements;
- It would not avoid or substantially lessen a significant (as defined in 43 CFR §46.420[b]) impact of the Proposed Action;
- It is environmentally infeasible, meaning implementation of the alternative would not be allowed by another agency from which a permit or approval is required or implementation results in an obvious and substantial increase in impacts on the human environment;[10]
- It is technically infeasible, or impractical, meaning implementation of the alternative is unlikely given past and current practice, technology (e.g., experimental turbine design or foundation type), or site conditions (e.g., presence of boulders) as determined by BOEM's technical experts;
- It is economically infeasible, meaning implementation of the alternative is unlikely due to unreasonable costs as determined by BOEM's technical experts; while this does not require cost-benefit analysis or speculation about an applicant's costs and profits, there must be a reasonable basis for the determination of economic infeasibility;
- It cannot be analyzed because its implementation is remote or speculative or it is too conceptual in that it lacks sufficient detail to meaningfully analyze impacts; or
- It is substantially similar in design to an alternative that is or will be analyzed in detail.

Table 2.2-1 lists the alternatives considered but not analyzed in detail and the rationale for their dismissal. These alternatives are presented with a brief discussion of the reasons for their elimination as prescribed in CEQ regulations at 40 CFR § 1502.14(a) and U.S. Department of the Interior regulations at 43 CFR § 46.420(b)–(c).

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[10] "Human environment means comprehensively the natural and physical environment and the relationship of present and future generations of Americans with that environment" (40 CFR § 1508.1(m)).

Table 2.2-1: Alternatives Considered but Not Analyzed in Detail

Alternative	Rationale for Dismissal
1. Alternative that uses a shared OECC	BOEM cannot dictate that a lessee use a shared cable corridor (30 CFR § 585.200(b)). While BOEM could require a lessee to use a previously existing shared cable corridor (30 CFR § 585.112); no such corridor exists. BOEM has no way of determining if the use of a future shared cable corridor would be a technically and economically practical and feasible alternative for the proposed Project. Therefore, BOEM cannot require the applicant to use a non-existent shared cable corridor for the proposed Project. Furthermore, the proposed Project's export cables would connect to the power grid via different onshore substations than other offshore wind projects (e.g., Mayflower Wind). Developing a shared export cable corridor would not be technically or economically practicable because each other offshore wind project has distinct interconnection points to the electric power grid. In addition, the proposed Project's preferred OECC is already collocated with the permitted Vineyard Wind 1 OECC. Under Alternative B, the two Phase 2 cable route variants (Western Muskeget Variant and SCV) would only be used if the preferred export cable route is found to be infeasible. Moreover, if the Western Muskeget Variant is used, the cable route would still be mostly collocated with the permitted Vineyard Wind 1 export cable corridor.
2. Alternative that installs three to five export cables in the Western Muskeget Variant	Installing three to five cables in the Western Muskeget Variant is economically and technically infeasible and impractical. The technical constraints include that the Western Muskeget Variant is deeper, up to about 148 feet MLLW, compared to the proposed (Eastern Muskeget) OECC route, up to about 82 feet MLLW. Steep slopes within the Eastern Muskeget route are associated with the edge of bedforms, which can be cleared through using a vertical injector. In contrast, steep slopes (slopes greater than 20 degrees) within the Western Muskeget Variant are associated with the edge of the Muskeget Channel, which is a significantly more technically challenging and dynamic environment for cable burial (COP Volume II-A, Figure 3.2-3b; Epsilon 2022). The steepest parts of the Muskeget Channel cross most of the surveyed Western Muskeget Variant, so routing even up to two cables around these steep slopes would be significantly technically challenging and risky due to limited available space for cable routing around future identified hazards such as large boulders or unexploded ordnance (Avangrid 2022a). Any potential future cable repairs along this route would also face similar risks. In addition, the channel acts to funnel currents, which leads to high scour potential and high cable installation risk along the deepest parts of the channel, which bisect the Western Muskeget Variant (Avangrid 2022a). Moreover, the Muskeget Channel thalweg (path tracing the lowest points through the channel) has been known to migrate (COP Volume II-A, Figure 3.2-5a; Epsilon 2022). Along the Western Muskeget route, the "channel's thalweg shifted over 197 feet to the east between 2010 and 2018 resulting in an elevation decrease of up to 30 feet at the 2018 channel thalweg location." Seabed erosion or deposition of up to 30 feet in an 8-year timeframe leads to significant risk of cable exposure or cable overheating during the lifespan of the proposed Project (COP Volume II-A; Epsilon 2022). Seabed erosion or deposition can lead to significant risk of cable exposure or cable overheating during the lifespan of the proposed Project. The Eastern Muskeget route does not exhibit channel and bedform migration or sediment mobility on the scale observed within the Western Muskeget Variant. In its comments during the scoping period for the New England Wind EIS, NMFS reiterated that it "support[s] consolidating impacts to one corridor…done through a full evaluation" (NMFS 2021a). Both the Eastern Muskeget route and Western Muskeget Variant were reviewed in the Vineyard Wind 1 Final EIS and remained in the approved Vineyard Wind 1 COP. After COP approval, Vineyard Wind, LLC (the applicant for the Vineyard Wind 1 Project) selected the Eastern Muskeget route for that project's OECC. Based on this input, and similar past input, the applicant for the proposed Project identified a preferred OECC that included the Vineyard Wind 1 Eastern Muskeget OECC, widened along its entire western boundary and eastern boundary within Muskeget Channel. These widenings allow for micro siting and collocation of the proposed Project's export cables (particularly for Phase 1 but potentially for both phases) with export cables for Vineyard Wind 1. As a result, the applicant only proposes to use the Western Muskeget Variant for up to two cables as a contingency if collocating all proposed Project cables in the Eastern Muskeget route is found to be technically infeasible. Taken together, these challenges demonstrate that installing up to five cables in the Western Muskeget Variant is economically and technically infeasible and impractical.

Alternative	Rationale for Dismissal
3. Alternative that places the Phase 1 export cables within either the SCV or the Western Muskeget Variant	Installing the Phase 1 cables in the SCV is not technically or economically feasible or practicable, consistent with BOEM's screening criteria because: • The interconnection point for the Phase 1 is fixed at the West Barnstable Substation through the ISO-NE transmission interconnection process. It is not technically or commercially feasible to land a cable on the south coast of Massachusetts (i.e., not on Cape Cod) and connect it to the West Barnstable Substation (Avangrid 2022a); and • Any interconnection to the south coast of Massachusetts (i.e., not on Cape Cod) is currently limited to 400 MW, which is half the capacity of Phase 1. Placing the two Phase 1 cables (with 800 MW of total capacity) in the SCV would delay transmission interconnection process for the proposed Project by years, due to the need to upgrade substations connected to the ISO-NE grid that are not currently planned for upgrade. This would jeopardize the proposed Project's PPAs (Avangrid 2022a). Similar to the reasoning for dismissing Alternative #2, placing the Phase 1 export cables within either the Western Muskeget Variant or SCV would be technically and economically infeasible and impracticable. While the applicant's cable scenarios (Table 2.1-2) include the installation of up to two Phase 2 export cables within the Western Muskeget Variant to provide maximum flexibility, the applicant believes it would be challenging to route even one cable within the Western Muskeget Variant for the technical reasons previously described (Avangrid 2022a). As a result, the Western Muskeget Variant is only proposed as a contingency for Phase 2. In addition, the applicant already has contractual agreements supporting cable installation that are specific to the Eastern Muskeget route for Phase 1 (Avangrid 2022a). Consequently, this alternative would require amendments or new contracts, which would be an additional cost to the applicant. The technical feasibility of using the Eastern Muskeget route for the two Phase 1 cables is significantly more certain than the technical feasibility of placing the two Phase 1 cables in the Western Muskeget Variant. Moreover, in this scenario, assuming the installation of two Phase 1 export cables in the Western Muskeget Variant (the maximum technically feasible capacity of that route), at least one export cable from Phase 2 would still need to use the Eastern Muskeget route to enable Phase 2 to achieve landfall in Barnstable County as currently proposed in the COP (Epsilon 2022). Landfall in Barnstable County for at least one Phase 2 export cable is necessary for the technical and economic feasibility for the proposed Project because the Barnstable County Landfall Site has the necessary capacity for over 400 MW of offtake, while the potential SCV points of interconnection only have a maximum offtake capacity of 400 MW (Avangrid 2022a). As a result, placing the Phase 1 cables in the Western Muskeget Variant would reduce the number of export cables (by one) being installed in the Eastern Muskeget route and would not eliminate a season of construction. Finally, the applicant has entered into a Host Community Agreement with the Town of Barnstable for its cable landings at Craigville Beach, onshore cable routes, and substation site under which the applicant will contribute $16 million as a host community fee. The applicant is nearing the end of the review by the Massachusetts Energy Facilities Siting Board of the cable route and interconnection to the West Barnstable Substation, and all state permit applications have been filed, with several permits already issued and the remainder expected by the end of 2022. The two Phase 1 cables are also currently designed to be located east of the Phase 2 cables. Moving the Phase 1 cables to a different landing site (i.e., through use of the SCV) would potentially create a new cable crossing scenario, which is generally something the applicant, BOEM, and cooperating agencies avoid, where practicable, because of the potential additional technical complexity and environmental impacts associated with crossings.

Alternative	**Rationale for Dismissal**
4. Alternative that includes wider structure-free corridors throughout the RI/MA Lease Areas, including the SWDA	The Responsible Offshore Development Alliance requested a 4-nautical mile-wide (4.6-mile-wide) corridor through the RI/MA Lease Areas, while New York State Department of State requested a 2- or 3-nautical-mile (2.3- or 3.4-mile) corridor (BOEM 2022b). Developers and applicants for projects in the RI/MA Lease Areas have agreed to develop (and have designed) all projects based on a uniform, orthogonal, 1- × 1-nautical-mile (1.15-mile) grid. USCG's May 2020 Final Massachusetts and Rhode Island Port Access Route Study recommended the same grid to maximize safety and navigation consistency (USCG 2020) and stated that 1- × 1-nautical-mile (1.15-mile) spacing provides ample maneuvering space for typical fishing vessels expected in the proposed Project area. Addition of wider routes could make the proposed Project economically infeasible because fewer WTGs would be installed, with an accompanying reduction in the amount of electricity generated.
5. Alternative that combines the most impactful components for each option included in the PDE	When BOEM conducts an environmental review of an applicant's COP, BOEM considers the maximum-case scenario, which identifies the most impactful parameters or technically feasible combination of parameters defined within the PDE for each resource area. For example, the maximum-case scenario for visual impacts includes the tallest WTGs for each proposed Project phase, whereas the maximum-case scenario for benthic resources involves the largest number of foundations and the smallest (lowest capacity) WTGs. Because BOEM already considers the maximum-case scenario as part of its review of Alternative B, the analysis of a maximum-case alternative and Alternative B would reach the same impact conclusion. This alternative was not carried forward for separate analysis because it is already analyzed in detail as Alternative B.
6. Alternative that considers suction bucket jacket and bottom-frame foundations for Phase 1	As described in Section 2.1.2, the applicant would install Phase 1 WTGs and ESPs on monopiles or jacket foundations with pin piles. The applicant would install Phase 2 WTGs and ESPs on monopiles, jacket, or bottom-frame foundations and could use either pin piles or suction buckets for jacket and bottom-frame foundations, which are not available for Phase 1. The COP describes the technical justifications for selecting or not selecting various foundation measures (Volume I, Section 3.2.3.3 for Phase 1 and Section 4.2.3.3 for Phase 2; Epsilon 2022). The applicant determined that the Phase 2 foundation types suggested by commenters were not suitable for Phase 1 due to local site conditions, as well as technical and supply chain considerations (COP Volume I, Section 3.2.3.3.3; Epsilon 2022). The suggested alternative would, therefore, be technically and economically infeasible and impractical.
7. Alternative that includes "Project modifications," as well as emerging technologies and methodologies	This alternative is vague, speculative, and does not address a specific significant impact or concern or provide sufficient detail to meaningfully analyze impacts; therefore, this alternative was not carried forward for separate analysis.
8. Alternative that requires use of the largest available WTGs to minimize the number of foundations constructed to meet the proposed Project capacity, minimize impacts on marine habitats and resources, and reduce navigation and other space-use concerns	The original commenter (RI-CRMC 2021) requested an alternative using WTGs with 12 MW or 13.6 MW capacity to avoid sensitive habitat and reduce overall impacts. These WTG sizes would be insufficient to generate the 2,036 MW from the 130 WTG positions necessary to satisfy existing energy offtake commitments for both phases of Alternative B, combined. In response to this comment, BOEM considered two scenarios that would allow development of the minimum number of positions necessary to meet the proposed Project's PPAs (804 MW for Phase 1 and at least 1,232 MW for Phase 2): • A scenario assuming WTGs with a minimum nameplate capacity of 16 MW and only one dedicated ESP position (some ESP equipment would be mounted on WTG platforms) would eliminate 18 WTG positions. • A scenario assuming a minimum nameplate capacity of 20 MW and no dedicated ESP positions (all ESP equipment would be mounted on WTG platforms) would eliminate 28 WTG positions. Upon close examination, BOEM eliminated this alternative from detailed analysis under the screening criteria because (1) the alternative is not economically feasible or practicable; (2) there is no scientific evidence that the alternative would avoid or substantially lessen one or more significant environmental impacts of the proposed Project; and (3) it does not meet the primary goals of the applicant, as it could result in implementation delays that would invalidate existing agreements and result in the development of a project that would not allow the developer to satisfy contractual offtake obligations that it is currently pursuing through upcoming state solicitation and ongoing negotiations. Each of these issues are discussed in more detail below.

Alternative	Rationale for Dismissal
	This alternative is not practicable or economically feasible Selecting a WTG design is only a choice between nameplate capacities. For the proposed Project, selection of WTG design cannot be deferred until the ROD under the current market conditions. Waiting until the ROD is issued to select a turbine capacity would delay final proposed Project design and engineering by at least 9 months and put the commercial viability of the proposed Project at significant risk by restricting the applicant's negotiating capacity and eliminating competitive bids by turbine suppliers due to the long lead time (years) needed to manufacture WTGs, design and manufacture foundations, and procure construction and installation services. There is no scientific evidence that the alternative would avoid or substantially lessen one or more significant environmental impacts of the proposed Project No specific sensitive habitats have been identified, and no specific areas were recommended by commenters for a potential "no surface occupancy" area to exclude WTG positions due to the need for navigation accommodations or other uses (other than those items addressed by the other alternatives in the Draft EIS). Some commenters broadly suggested that Atlantic cod (*Gadus morhua*) and/or North Atlantic right whale (NARW; *Eubalaena glacialis*) could benefit from a smaller proposed Project footprint. However, "SMAST bottom trawl surveys conducted between spring 2019 and winter 2022 caught only 23 individual Atlantic cod in the lease area for an average of 0.23 cod per tow" (Avangrid 2022a). A review of data from the New England Fishery Management Council shows low to no abundance of cod in and around the lease area (Avangrid 2022a). "Based on available habitat data, cod spawning within the lease area is unlikely given the lack of 'rough bottom habitat' or complex habitat suitable for spawning Atlantic cod. Benthic surveys showed that the lease area is wholly dominated by soft bottom habitat: unconsolidated substrate dominated by sand and silt-sized particles" (Avangrid 2022a). Further, most Atlantic cod spawning occurs inshore (Fahay et al. 1999). In the event cod spawn in the RI/MA Lease Areas, the applicant has proposed pile-driving restrictions from January 1st to April 30th to protect NARW (Appendix H), which would also confer benefits to Atlantic cod that spawn in southern New England waters between November and April (NMFS 2021a). Noise mitigation systems would also be implemented to reduce potential sound exposure in the environment (Section 2.1.2 and Appendix H). It is likely that impacts from proposed Project activities could temporarily disturb aggregated Atlantic cod if any occur in the lease area during construction. However, the fish exhibit strong site fidelity when they are reproductively active. Because impulsive acoustic impacts (e.g., pile driving) would be of limited duration, and the duration and areal extent of other bottom-disturbing activities (e.g., site preparation and cable installation) at any location would be limited, permanent dispersion of aggregated Atlantic cod is unlikely to occur (BOEM 2021b). Lastly, scientists studying the Block Island Wind Farm have found that catch of structure-oriented species, such as black sea bass (*Centropristis striata*) and Atlantic cod, increased at Block Island Wind Farm following turbine installation (Wilber et al. 2022). Regarding NARWs, the densities in the proposed Project area are low from May to December, when construction activities would take place (Section 3.7, Marine Mammals). The applicant would employ numerous mitigation and monitoring measures anticipated to be required by the Letter of Authorization issued by NMFS and as reasonable and prudent measures from the ESA consultation. Likely mitigation and monitoring measures for NARW and other species listed in Appendix H include, but are not limited to, seasonal pile-driving restriction cited above, sound attenuation technology, soft starts, protection clearance and shut-down zones, PSOs, passive acoustic monitoring, and vessel strike avoidance measures. As applicable, the same measures would be employed during proposed Project operations. This alternative does not meet the applicant's primary goals This alternative does not account for the fact that the applicant is currently pursuing offtake agreements for up to approximately 550 MW and would need the majority of the remaining area of the lease to compete as planned in upcoming state solicitations (e.g., Massachusetts), consistent with their primary goals. Under this alternative, it would be impossible for the proposed Project to meet the minimum procurement size of 400 MW for Massachusetts. Obtaining additional offtake agreement(s) is a critical component of the proposed Project's financing mechanism, particularly given recent increases in the cost of steel, proposed Project components (e.g., electrical components), and services, such as installation vessels.

Alternative	Rationale for Dismissal
9. Alternative that includes routing the SCV OECC between Martha's Vineyard and Nomans Island to reduce impacts on seafloor resources	The proposed route of the SCV OECC reflects coordination with tribal representatives to specifically avoid impacts on submerged ancient landforms within the Vineyard Sound and Moshup's Bridge TCP, including the area between Martha's Vineyard and Nomans Island. The suggested alternative would require routing through the TCP. Whereas impacts on benthic or biological species along the currently proposed route can potentially be avoided or mitigated, impacts on submerged landforms that contribute to the TCP cannot be mitigated.
10. Alternative that collocates the SCV OECC with the Mayflower Wind OECC within and approaching Buzzards Bay	See the discussion for Alternative #1 in this table. At this time, the factors considered for Alternative #1 and this alternative outweigh any potential future decrease in collective seabed disturbance that may result from having multiple projects sharing one cable corridor. In addition, sufficient information to develop an alternative to the SCV that is technically feasible was not available at the time of this Draft EIS. If the applicant determines that use of the SCV is necessary in a future COP revision pursuant to 30 CFR § 585.634, alternatives to the SCV would be considered in a supplemental NEPA analysis.
11. Alternative that eliminates the SCV as an option for Phase 2	The SCV would connect to a potential second grid interconnection point in Bristol County, Massachusetts (COP Volume I, Section 4.1.3.3; Epsilon 2022) to provide the commercial flexibility required should technical, logistical, grid interconnection, or other unforeseen issues arise that preclude one or more Phase 2 export cables from interconnecting in Barnstable, Massachusetts. Precluding the use of the SCV could render the proposed Project infeasible by removing the potentially necessary OECC and grid interconnection point for Phase 2. If the SCV becomes necessary, the applicant would be required to file a COP revision pursuant to 30 CFR § 585.634, and alternatives to the SCV would be considered in a supplemental NEPA analysis.
12. Alternative that approves only Phase 1 or Phase 2	BOEM considered a No Action Alternative that would only approve either Phase 1 or Phase 2 of the proposed Project and determined this alternative was not economically feasible for the following reasons: • The applicant has already entered into electricity offtake agreements with the State of Connecticut and the Commonwealth of Massachusetts that specify the price of electricity and timing of the applicant's commitments. The applicant's bid on the state solicitations incorporated certain economic assumptions, including a lease-wide permitting approach for applicant financing in order to be economically viable. This approach includes starting construction of part of Phase 2 immediately following Phase 1, allowing for continuous construction and installation across both phases (COP Volume I, Section 4.1.1.3; Epsilon 2022). • Efficiencies and economies of scale associated with joint development of Phase 1 and Phase 2, including finalized contracts, would not be realized if a permitting decision were only made for either phase. This includes single competitive contracts being awarded to entities that can demonstrate their ability to reduce costs of, and associated with, several major proposed Project components, including cables, WTGs, foundations, and scour protection. Several services related to the proposed Project are also synergized across both phases, including design contractors, permitting consultants, marine warranty surveyor contracts, and offshore logistics for CTVs and SOVs. • Separating the environmental review process for Phase 1 and Phase 2 would increase uncertainty with respect to proposed Project costs, timelines, and regulatory processes and conditions, thereby increasing risk. This risk could translate to higher financing costs or inability to obtain financing with respect to commercial transactions (financing by third parties other than the applicant).

BOEM = Bureau of Ocean Energy Management; CFR = Code of Federal Regulations; COP = Construction and Operations Plan; CTV = crew transfer vessel; EIS = Environmental Impact Statement; ESA = Endangered Species Act; ESP = electrical service platform; MLLW = mean lower low water; MW = megawatt; NARW = North Atlantic right whale; NEPA = National Environmental Policy Act; NMFS = National Marine Fisheries Service; OECC = offshore export cable corridor; PDE = Project design envelope; PPA = power purchase agreement; PSO = protected species observer; RI/MA Lease Areas = Rhode Island and Massachusetts Lease Areas; ROD = Record of Decision; SCV = South Coast Variant; SMAST = University of Massachusetts Dartmouth's School for Marine Science and Technology; SOV = service operation vessel; SWDA = Southern Wind Development Area; TCP = traditional cultural property; USCG = U.S. Coast Guard; WTG = wind turbine generator

2.3 Non-Routine Activities and Low-Probability Events

Non-routine activities and low-probability events could occur during construction, operations, or decommissioning of the proposed Project. Examples include corrective maintenance activities; collisions between vessels or allisions (a vessel striking a stationary object), between vessels and WTGs or ESPs, or vessels and marine life; cable displacement or damage by anchors or fishing gear; chemical spills or releases; severe weather and other natural events; and/or terrorist attacks. This section provides a brief assessment of these potential events or activities, as follows:

- *Corrective maintenance activities:* These activities could be required as a result of low-probability events or of unanticipated equipment wear or malfunctions.
- *Collisions and allisions:* These could result in spills (described below), human injuries or fatalities, or wildlife injuries or fatalities (addressed in Chapter 3 and Appendix A, Required Environmental Permits and Consultations). Collisions and allisions are anticipated to be unlikely because the proposed Project would:
  - Implement USCG requirement for lighting on vessels;
  - Exclude high vessel traffic areas from the Rhode Island and Massachusetts Lease Areas (RI/MA Lease Areas);
  - Implement National Oceanic and Atmospheric Administration (NOAA) vessel strike guidance, as practicable;
  - Apply proposed spacing between WTGs and other facility components;
  - Implement lighting and marking, as required by USCG and BOEM; and
  - Include proposed Project components on nautical charts.
- *Cable displacement or damage by vessel anchors or fishing gear:* This could result in safety concerns for vessels and economic damages for vessel operators and could require corrective action by the applicant. However, such incidents are unlikely to occur because the proposed Project would be indicated on navigational charts, and the cable would be buried at least 5 feet deep or protected with hard armor.
- *Chemical spills or releases:* For offshore activities, these include inadvertent releases from refueling vessels, spills from routine maintenance activities, collisions and allisions (as described above), and any significant spills resulting from a catastrophic event. The applicant would comply with USCG and BSEE regulations relating to prevention and control of oil spills. In addition, spill impacts would be minimized by adhering to the OSRP included in COP Appendix I-F (Epsilon 2022). Additional information related to potential spills can be found in the navigational safety risk assessment (NSRA) (COP Appendix III-I; Epsilon 2022). Onshore, releases could potentially occur from construction equipment and/or HDD activities. Additionally, a spill prevention, control, and countermeasure plan would be prepared in accordance with applicable requirements and outline spill prevention plans and measures to contain and clean up spills that could occur.
- *Severe weather and natural events:* Historical severe weather trends in the proposed Project area are described in Section B.1 of Appendix B, Supplemental Information and Additional Figures and Tables. The applicant designed the proposed Project components to withstand severe weather events (COP Volume III, Section 8.2; Epsilon 2022). WTGs would automatically shut down when wind speeds exceed safe operating speed, and structures would be designed to withstand high waves. If severe weather caused a spill or release, implementation of the OSRP and spill prevention, control, and countermeasure plan would help reduce potential impacts. Severe flooding or coastal erosion could require repairs, with impacts associated with repairs being similar to those outlined in Chapter 3 during

construction activities. While highly unlikely, WTG structural failure (i.e., loss of a blade or tower collapse) would result in temporary hazards to navigation for all vessels, similar to the construction impacts described in Chapter 3.

- *Terrorist attacks:* BOEM considers these unlikely, but impacts could vary depending on the magnitude and extent of any attacks. The actual impacts of this type of activity would be the same as the outcomes listed above. Therefore, terrorist attacks are not analyzed further.

2.4 Summary and Comparison of Impacts by Alternatives

Table 2.4-1 summarizes and compares the impacts under each action alternative and includes each action alternative alone, the impacts of other planned activities (specifically other planned offshore wind projects) without Alternative B (e.g., Alternative A), and the cumulative impacts of each action alternative in combination with other planned activities. Each resource section in Chapter 3 provides definitions for **negligible**, **minor**, **moderate**, and **major** impacts (both adverse and beneficial, where appropriate). Resources with overall adverse impact ratings no greater than **minor** are analyzed in Appendix G, Impact-Producing Factor Tables and Assessment of Resources with Minor (or Lower) Impacts, while other resources are analyzed in Chapter 3. All impact levels are assumed to be adverse unless specified as beneficial. Where impacts are presented as multiple levels, the table color represents the most adverse level of impact. Although the detailed description of potential impacts could vary across action alternatives, as described in Chapter 3 and Appendix G, many of the differences in potential impacts across alternatives do not warrant differences in impact ratings based on the definitions used.

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

Table 2.4-1: Impacts by Action Alternative Resource Affected With No Mitigation Measures

Resources	**Alternative B**[a, b]	**Alternative C**[a, b]
Benthic Resources: *Project Impacts*	**Negligible** to **Moderate**	**Negligible** to **Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Benthic Resources: *Planned Activities without Project Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Benthic Resources: *Cumulative Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Coastal Habitats and Fauna: *Project Impacts*	**Minor** to **Moderate**	**Minor** to **Moderate**
	Minor Beneficial	**Minor Beneficial**
Coastal Habitats and Fauna: *Planned Activities without Project Impacts*	**Moderate**	**Moderate**
	Minor Beneficial	**Minor Beneficial**
Coastal Habitats and Fauna: *Cumulative Impacts*	**Minor** to **Moderate**	**Minor** to **Moderate**
	Minor Beneficial	**Minor Beneficial**
Finfish, Invertebrates, and Essential Fish Habitat: *Project Impacts*	**Negligible to Moderate**	**Negligible to Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Finfish, Invertebrates, and Essential Fish Habitat: *Planned Activities without Project Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Finfish, Invertebrates, and Essential Fish Habitat: *Cumulative Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Marine Mammals: *Project Impacts*	**Negligible to Moderate**	**Negligible to Moderate**
	Minor Beneficial	**Minor Beneficial**
Marine Mammals: *Planned Activities without Project Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Marine Mammals: *Cumulative Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**

Resources	**Alternative B[a, b]**	**Alternative C[a, b]**
Sea Turtles: *Project Impacts*	**Negligible to Moderate**	**Negligible to Moderate**
	Minor Beneficial	**Minor Beneficial**
Sea Turtles: *Planned Activities without Project Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Sea Turtles: *Cumulative Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Commercial Fisheries and For-Hire Recreational Fishing: *Project Impacts*	**Negligible to Moderate**	**Negligible to Moderate**
	Minor Beneficial	**Minor Beneficial**
Commercial Fisheries and For-Hire Recreational Fishing: *Planned Activities without Project Impacts*	**Moderate to Major**	**Moderate to Major**
	Minor Beneficial	**Minor Beneficial**
Commercial Fisheries and For-Hire Recreational Fishing: *Cumulative Impacts*	**Major**	**Major**
	Minor Beneficial	**Minor Beneficial**
Cultural Resources: *Project Impacts*	**Moderate**	**Moderate**
Cultural Resources: *Planned Activities without Project Impacts*	**Minor to Major**	**Moderate**
Cultural Resources: *Cumulative Impacts*	**Minor to Major**	**Minor to Major**
Demographics, Employment, and Economics: *Project Impacts*	**Minor**	**Minor**
	Minor Beneficial	**Minor Beneficial**
Demographics, Employment, and Economics: *Planned Activities without Project Impacts*	**Minor**	**Minor**
	Moderate Beneficial	**Moderate Beneficial**
Demographics, Employment, and Economics: *Cumulative Impacts*	**Minor**	**Minor**
	Moderate Beneficial	**Moderate Beneficial**
Environmental Justice: *Project Impacts*	**Minor**	**Minor**
	Minor Beneficial	**Minor Beneficial**
Environmental Justice: *Planned Activities without Project Impacts*	**Minor**	**Minor**
	Minor Beneficial	**Minor Beneficial**

Resources	**Alternative B[a, b]**	**Alternative C[a, b]**
Environmental Justice: *Cumulative Impacts*	**Minor**	**Minor**
	Minor Beneficial	**Minor Beneficial**
Navigation and Vessel Traffic: *Project Impacts*	**Negligible to Moderate**	**Negligible to Moderate**
Navigation and Vessel Traffic: *Planned Activities without Project Impacts*	**Moderate**	**Moderate**
Navigation and Vessel Traffic: *Cumulative Impacts*	**Negligible to Moderate**	**Negligible to Moderate**
Other Uses: *Project Impacts*	**Minor** to **Moderate** for National security and military; **Minor** for aviation and air traffic; **Negligible** for offshore cables and pipelines and marine minerals; **Minor** to **Moderate** for radar systems; and **Major** for scientific research and surveys	**Minor** to **Moderate** for national security and military; **Minor** for aviation and air traffic; **Negligible** for offshore cables and pipelines and marine minerals; **Moderate** for radar systems; and **Major** for scientific research and surveys
Other Uses: *Planned Activities without Project Impacts*	**Negligible** for marine minerals; **Negligible to Minor** for aviation and air traffic and offshore cables and pipelines; **Minor** for national security and military; **Moderate** for radar systems; and **Major** for scientific research and surveys and USCG SAR activities	**Negligible** for marine minerals**; Negligible to Minor** for aviation and air traffic and offshore cables and pipelines; **Minor** for national security and military; **Moderate** for radar systems; and **Major** for scientific research and surveys and USCG SAR activities
Other Uses: *Cumulative Impacts*	**Minor** to **Major** for national security and military; **Minor** for aviation and air traffic; **Negligible** for offshore cables and pipelines and marine minerals; **Moderate** for radar systems; and **Major** for scientific research and surveys	**Minor** to **Major** for national security and military; **Minor** for aviation and air traffic; **Negligible** for offshore cables and pipelines and marine minerals; **Moderate** for radar systems; and **Major** for scientific research and surveys
Recreation and Tourism: *Project Impacts*	**Minor**	**Minor**
	Minor Beneficial	**Minor Beneficial**
Recreation and Tourism: *Planned Activities without Project Impacts*	**Moderate**	**Moderate**
	Minor Beneficial	**Minor Beneficial**
Recreation and Tourism: *Cumulative Impacts*	**Moderate**	**Moderate**
	Minor Beneficial	**Minor Beneficial**
Scenic and Visual Resources: *Project Impacts*	**Minor**	**Minor**
Scenic and Visual Resources: *Planned Activities without Project Impacts*	**Minor** to **Major**	**Minor** to **Major**
Scenic and Visual Resources: *Cumulative Impacts*	**Moderate to Major**	**Moderate to Major**

Resources	**Alternative B[a, b]**	**Alternative C[a, b]**
Air Quality: *Project Impacts*	**Minor**	**Minor**
	Moderate Beneficial	**Moderate Beneficial**
Air Quality: *Planned Activities without Project Impacts*	**Minor**	**Minor**
	Minor to **Moderate Beneficial**	**Minor** to **Moderate Beneficial**
Air Quality: *Cumulative Impacts*	**Minor**	**Minor**
	Moderate Beneficial	**Moderate Beneficial**
Water Quality: *Project Impacts*	**Minor**	**Minor**
Water Quality: *Planned Activities without Project Impacts*	**Minor** to **Moderate**	**Minor** to **Moderate**
Water Quality: *Cumulative Impacts*	**Minor to Moderate**	**Minor to Moderate**
Bats: *Project Impacts*	**Negligible**	**Negligible**
Bats: *Planned Activities without Project Impacts*	**Negligible**	**Negligible**
Bats: *Cumulative Impacts*	**Negligible**	**Negligible**
Birds: *Project Impacts*	**Negligible** to **Minor**	**Negligible** to **Minor**
	Minor Beneficial	**Minor Beneficial**
Birds: *Planned Activities without Project Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Birds: *Cumulative Impacts*	**Moderate**	**Moderate**
	Moderate Beneficial	**Moderate Beneficial**
Terrestrial Habitats and Fauna: *Project Impacts*	**Minor**	**Minor**
Terrestrial Habitats and Fauna: *Planned Activities without Project Impacts*	**Minor to Moderate**	**Minor to Moderate**
Terrestrial Habitats and Fauna: *Cumulative Impacts*	**Moderate**	**Moderate**
Wetlands and Other Waters of the United States: *Project Impacts*	**Negligible**	**Negligible**
Wetlands and Other Waters of the United States: *Planned Activities without Project Impacts*	**Minor**	**Minor**
Wetlands and Other Waters of the United States: *Cumulative Impacts*	**Minor**	**Minor**
Land Use and Coastal Infrastructure: *Project Impacts*	**Minor**	**Minor**
	Minor Beneficial	**Minor Beneficial**

Resources	**Alternative B[a, b]**	**Alternative C[a, b]**
Land Use and Coastal Infrastructure: *Planned Activities without Project Impacts*	**Minor**	**Minor**
	Minor Beneficial	**Minor Beneficial**
Land Use and Coastal Infrastructure: *Cumulative Impacts*	**Minor**	**Minor**
	Minor Beneficial	**Minor Beneficial**

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

Impact rating colors are as follows: orange = **major**; yellow = **moderate**; blue = **minor**; white = **negligible**; green = **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.

[a] Planned activities without Project impacts includes the impacts evaluated in Alternative A.

[b] Cumulative impacts includes the proposed Project in combination with other ongoing and planned activities.

3 Affected Environment and Environmental Consequences

This chapter analyzes the impacts of the Proposed Action and alternatives by establishing existing conditions of affected resources, predicting impacts, and then evaluating those impacts when added to existing conditions and considered in the context of the reasonably foreseeable impacts of future planned activities. This chapter, thus, addresses the affected environment (i.e., existing conditions) for each resource area and the potential environmental consequences to (i.e., impacts on) those resources from implementation of the alternatives described in Chapter 2, Alternatives. In addition, this chapter addresses the impact of the alternatives when combined with other past, present, or planned activities (i.e., cumulative impacts) using the methodology and assumptions outlined in Chapter 1, Introduction, and Appendix E, Planned Activities Scenario. Appendix E describes other ongoing and planned activities within the geographic analysis area for each resource. These actions may be occurring on the same time scale as the proposed Project or could occur later in time but are still reasonably foreseeable.

In accordance with the CEQ regulations implementing NEPA (40 CFR §1502.21), BOEM identified information that was incomplete or unavailable for the evaluation of reasonably foreseeable impacts. The identification and assessment of incomplete or unavailable information is presented in Appendix F, Analysis of Incomplete or Unavailable Information and Other Required Analyses.

3.1 Impact-Producing Factors

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

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

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

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

Table 3.1-1: Primary Impact-Producing Factors Addressed in This Analysis

IPF	**Sources and/or Activities**	**Description**
Accidental releases	• Mobile sources (e.g., vessels) • Installation, operation, and maintenance of onshore or offshore stationary sources (e.g., renewable energy structures, transmission lines, cables)	Refers to unanticipated release or spills into receiving waters of a fluid or other substance, such as fuel, hazardous materials, suspended sediment, invasive species, trash, or debris. Accidental releases are distinct from routine discharges, which typically consist of authorized operational effluents controlled through treatment and monitoring systems and permit limitations.
Air emissions	• Internal combustion engines (such as generators) aboard stationary sources or structures • Internal combustion engines within mobile sources such as vessels, vehicles, or aircraft	Refers to the release of gaseous or particulate pollutants into the atmosphere. Releases can occur onshore and offshore.
Anchoring and gear utilization	• Anchoring of vessels • Attachment of a structure to the sea bottom by use of an anchor, mooring, or gravity-based weighted structure (i.e., bottom-founded structure)	Refers to an activity or action that attaches objects to the seafloor. Gear utilization refers to entanglement and bycatch from gear utilization during fisheries and benthic monitoring surveys.
Cable emplacement and maintenance	• Dredging or trenching • Cable placement • Seabed profile alterations • Sediment deposition and burial • Mattress and rock placement	Refers to an activity or action associated with installing new offshore submarine cables on the seafloor, commonly associated with offshore wind energy.
Climate change	• Emissions of GHGs	Refers to the impacts of climate change, such as warming and sea level rise and increased storm severity or frequency. Ocean acidification refers to the impacts associated with the decreasing pH of seawater from rising levels of atmospheric CO_2.
Discharges/intakes	• Vessels • Structures • Onshore point and non-point sources • Dredged material ocean disposal • Installation, operation, and maintenance of submarine transmission lines, cables, and infrastructure	Generally refers to routine permitted operational effluent discharges to receiving waters. There can be numerous types of vessel and structure discharges, such as bilge water, ballast water, deck drainage, gray water, fire suppression system test water, chain locker water, exhaust gas scrubber effluent, condensate, and seawater cooling system effluent, among others. These discharges are generally restricted to uncontaminated or properly treated effluents that may have best management practice or numeric pollutant concentration limitations as required through USEPA NPDES permits or USCG regulations. The discharge of dredged material refers to the deposition of sediment at approved offshore disposal sites.

IPF	Sources and/or Activities	Description
EMF	• Substations • Power transmission cables • Inter-array cables • Electricity generation	Power generation facilities and cables produce electric fields (proportional to the voltage) and magnetic fields (proportional to flow of electric current) around the power cables and generators. Three major factors determine levels of the magnetic and induced electric fields from offshore wind energy projects: 1) the amount of electrical current being generated or carried by the cable, 2) the design of the generator or cable, and 3) the distance of organisms from the generator or cable.
Land disturbance	• Onshore construction • Onshore land use changes • Erosion and sedimentation • Vegetation clearance	Refers to land disturbances related to any onshore construction activities.
Lighting	• Vessels or offshore structures above or under water • Onshore infrastructure	Refers to lighting associated with offshore wind development and activities that use offshore vessels and may produce light above the water onshore and offshore, as well as underwater.
Noise	• Aircraft • Vessels • Turbines • G&G surveys • Operations and maintenance • Onshore and offshore construction and installation • Pile driving • Dredging and trenching	Refers to noise from various sources and commonly associated with construction activities, G&G surveys, and vessel traffic. May be impulsive (e.g., pile driving) or broad spectrum and continuous (e.g., from proposed Project-associated marine transportation vessels). May also be noise generated from turbines themselves or interactions of the turbines with wind and waves.
Port utilization	• Expansion and construction • Maintenance • Use • Revitalization	Refers to an activity or action associated with port activity, upgrades, or maintenance that occurs only as a result of the proposed Project. Includes activities related to port expansion and construction from increased economic activity and maintenance dredging or dredging to deepen channels for larger vessels.

IPF	Sources and/or Activities	Description
Presence of structures	• Onshore and offshore structures including towers and transmission cable infrastructure	Refers to an activity or action associated with onshore or offshore structures other than construction-related impacts, including the following: • Space-use conflicts • Fish aggregation and/or dispersion • Bird attraction and/or displacement • Marine mammal attraction and/or displacement • Sea turtle attraction and/or displacement • Scour protection • Allisions • Entanglement and/or gear ingestion • Gear loss and/or damage • Fishing effort displacement • Habitat alteration (creation or destruction) • Behavioral disruption (migration or breeding) • Navigation hazard • Seabed alterations • Turbine strikes (birds, bats) • Viewshed (physical, light) • Microclimate and circulation effects (above and below water)
Traffic	• Aircraft • Vessels • Vehicles	Refers to marine and onshore vessel and vehicle congestion, including vessel strikes of sea turtles and marine mammals, collisions, and allisions.

CO_2 = carbon dioxide; EMF = electromagnetic field; G&G = geophysical and geotechnical; GHG = greenhouse gas; IPF = impact-producing factor; NPDES = National Pollutant Discharge Elimination System; USCG = U.S. Coast Guard; USEPA = U.S. Environmental Protection Agency

3.2 Mitigation Identified for Analysis in the Environmental Impact Statement

During the development of the Draft EIS and in coordination with cooperating agencies, BOEM considered potential mitigation and monitoring measures, in addition to those committed to by the applicant, that could further avoid, minimize, or mitigate impacts on the physical, biological, socioeconomic, and cultural resources assessed in this document. These potential additional measures are described in Appendix H, Mitigation and Monitoring, and analyzed in the relevant resource sections in this chapter. BOEM may choose to incorporate one or more of these additional mitigation and monitoring measures in the preferred alternative. In addition, other mitigation and monitoring measures may be required through consultations, authorizations, and permits with respect to several environmental statutes, such as the MMPA, Section 7 of the ESA, or the MSA. Those additional measures presented in Appendix H may not be within BOEM's statutory and regulatory authority; however, other jurisdictional governmental agencies may require them. Mitigation and monitoring measures for completed consultations, authorizations, and permits will be included in the Final EIS. BOEM may choose to incorporate one or more additional measures in the ROD and adopt those measures as conditions of COP approval. As previously discussed, all applicant-committed mitigation and monitoring measures are part of the Proposed Action (see Chapter 2, Alternatives, for details).

3.3 Definition of Impact Levels

The EIS uses a four-level classification scheme for adverse and beneficial impacts (negligible, minor, moderate, and major) to characterize the potential impacts of the alternatives, including the Proposed Action. Resource-specific adverse and beneficial impact level definitions are presented in each resource section.

With regard to temporal extent, the Draft EIS assumes that potential construction impacts diminish once construction ends; however, ongoing operations activities could result in additional impacts for the 30-year operational life of the proposed Project. Additionally, the applicant would have up to an additional 2 years to complete decommissioning activities. Therefore, the Draft EIS considers the timeframe beginning with construction and ending when the proposed Project's decommissioning is complete, unless otherwise noted. As stated in Chapter 2, Alternatives, the proposed Project would have a 30-year operating period.

The Draft EIS uses the following duration terms:

- Temporary impacts: This includes impacts that end as soon as the activity ceases. An example would be road closures or traffic delays during onshore cable installation. Once construction is complete, the impact would end.
- Short-term impacts: This includes impacts that extend beyond construction, potentially lasting for several months but not for several years or longer. An example would be clearing of roadside landscaping during construction; the area would be revegetated when construction is complete, and once revegetation is successful, this impact would end.
- Long-term impacts: This includes impacts that last for a long period of time, potentially exceeding the life of the proposed Project (e.g., decades or longer). An example would be the loss of habitat where a WTG or ESP foundation has been installed.
- Permanent impacts: This includes impacts that extend beyond the life of the proposed Project. An example would be the conversion of land to support new onshore facilities or the placement of scour protection that is not removed as part of decommissioning.

For each resource, the Draft EIS first analyzes the No Action Alternative to predict the impacts of existing conditions (as described in Section 1.6.1). The Draft EIS then assesses the cumulative impacts on existing conditions as future planned activities—other than the Proposed Action—occur (as described in Section 1.6.2). Separate impact conclusions are drawn based on these separate analyses. This Draft EIS also conducts separate analyses to evaluate the impacts of the Proposed Action and action alternatives when added to existing conditions of resources (as described in Section 1.6.1) and to evaluate cumulative impacts by analyzing the incremental impacts of the action alternatives when added to both existing conditions and the impacts of future planned activities (as described in Section 1.6.2).

3.4 Benthic Resources

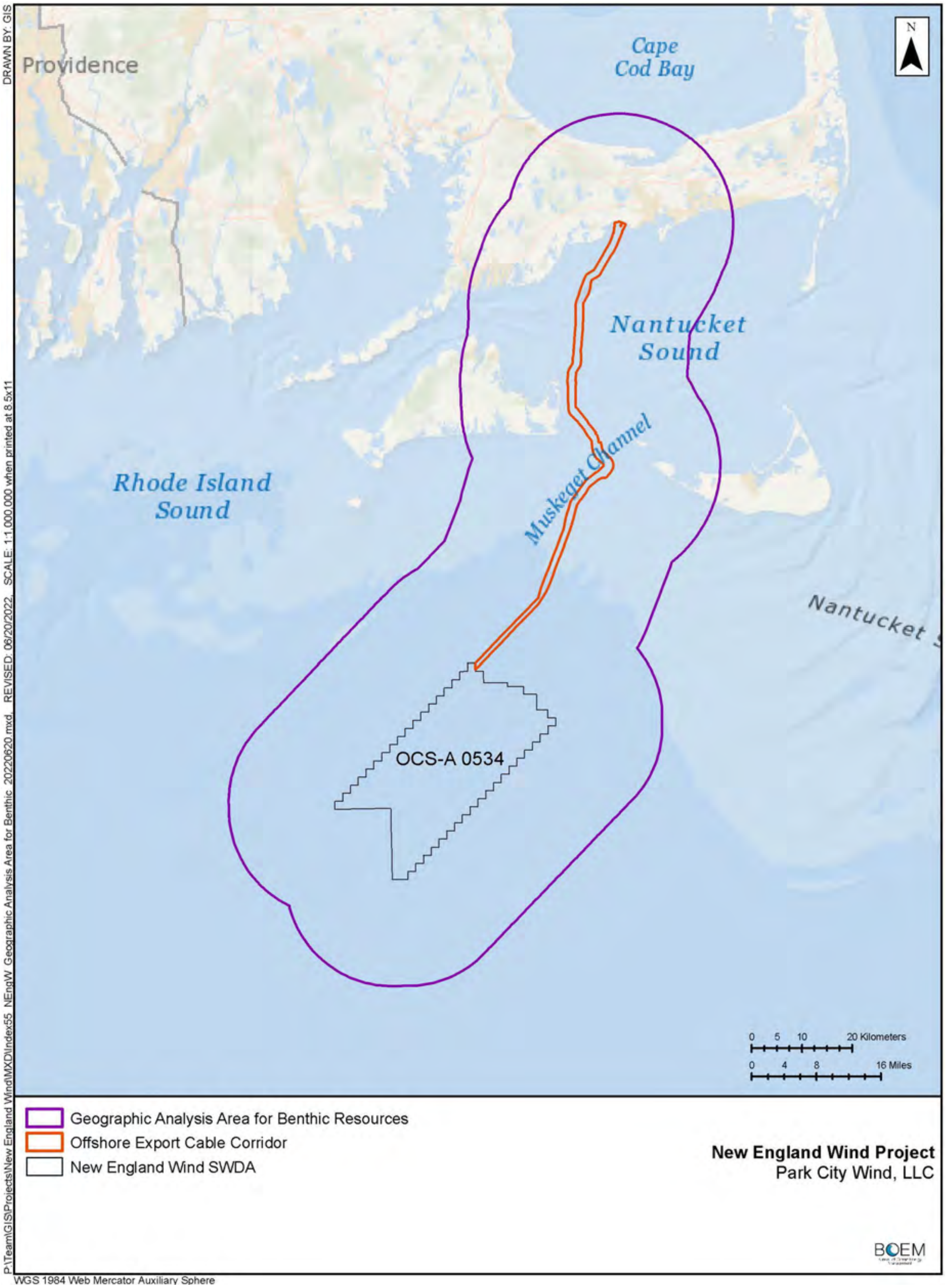
3.4.1 Description of the Affected Environment

This section discusses existing benthic resources in the geographic analysis area, as described in Table D-1 in Appendix D, Geographical Analysis Areas, and shown on Figure 3.4-1. This includes a 10-mile radius around the SWDA and the OECC. These buffers account for benthic invertebrate larval transport due to regional oceanographic conditions. Although sediment transport beyond 10 miles is possible, sediment transport related to proposed Project activities would likely be limited to a smaller spatial scale than 10 miles (COP Volume III, Appendix III-A; Epsilon 2022a).

Benthic resources include the seafloor surface, the substrate, and the associated communities of bottom-dwelling organisms that live there. Benthic habitats include soft-bottom (e.g., mud and sand) and hard-bottom (e.g., gravel, cobble, boulder, and bedrock) habitats, as well as biogenic habitats (e.g., eelgrass, mussel beds, and worm tubes) created by structure-forming species. Benthic habitat in the geographic analysis area is estimated to cover 1,164,963 acres, of which approximately 80 percent is sand, 15 percent is gravel/cobble/boulder, and 5 percent is mud/silt (The Nature Conservancy 2014). Benthic faunal resources in the geographic analysis area include polychaetes, crustaceans (particularly amphipods), mollusks (gastropods and bivalves), echinoderms (sand dollars, brittle stars, and sea cucumbers), and various other groups (sea squirts and burrowing anemones) (Guida et al. 2017). The spatial and temporal variation in benthic prey organisms can affect the growth, survival, and population dynamics of fishes and other higher trophic level organisms.

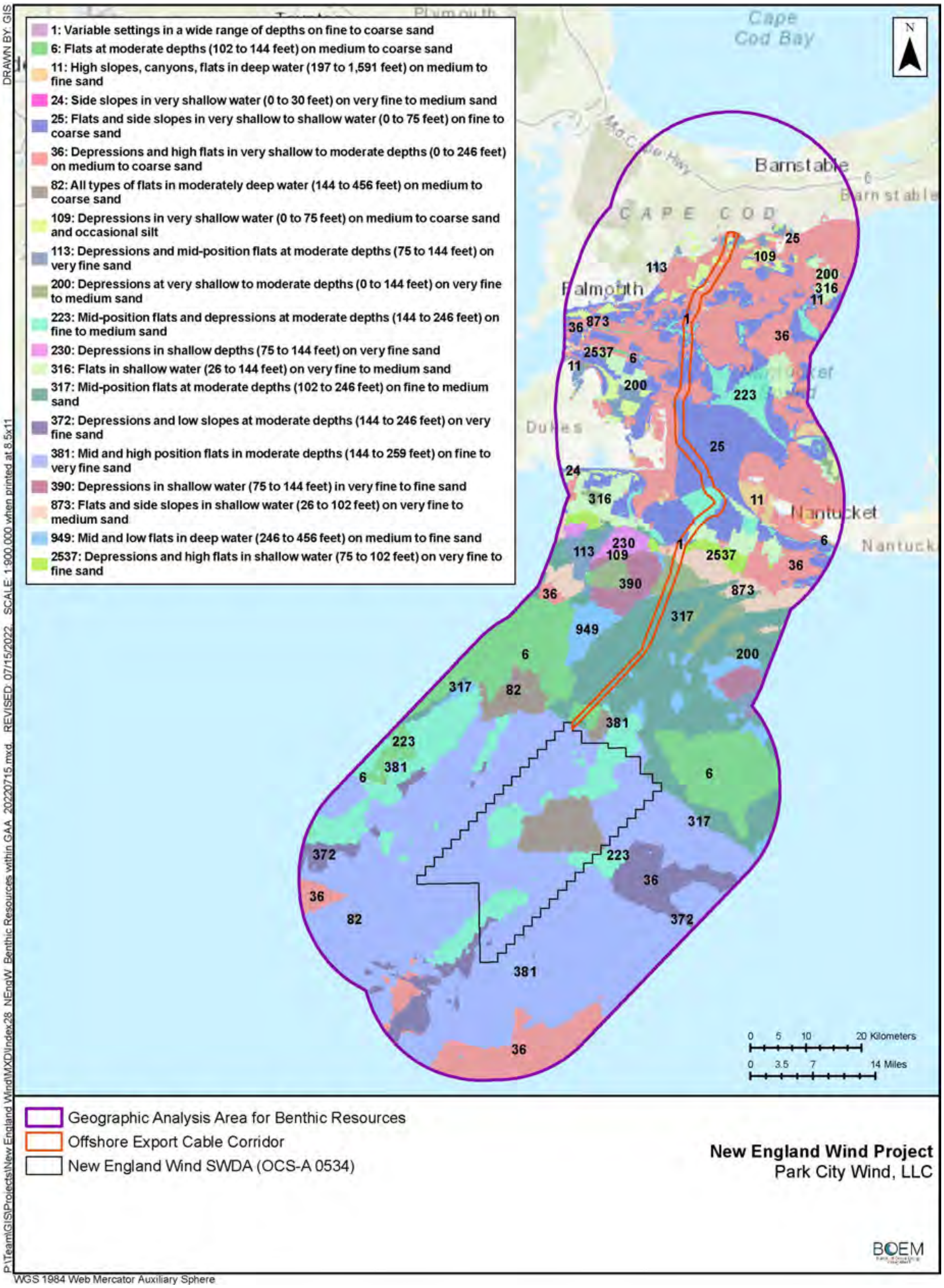
3.4.1.1 Habitat

The seafloor in the OECC and SWDA is predominantly composed of unconsolidated sediments ranging from silt and fine-grained sands to gravel. The SWDA is comprised entirely of fine unconsolidated substrate with predominantly sand and silt-sized material (COP Volume III, Section 6.5.1.1; Epsilon 2022a). Local hydrodynamic conditions largely determine sediment types, with finer materials in low-current areas and coarser materials in high-current areas. Coarser materials on the seafloor include gravel, cobble, and boulders, which are typically mixed with a matrix of finer sediments and usually found among discontinuous patches of sand (BOEM 2021b). This patchy distribution of coarse material (representative of coarse glacial till or end moraine deposits) is most common in high current areas, such as in the Muskeget Channel region (Figure 3.4-2) and northwest of Horseshoe Shoal in the North Channel (COP Volume II, Table 2.1-1 Volume II; Epsilon 2022a). The applicant did not identify any hard-bottom habitat in the SWDA. Hard-bottom habitat has been documented within the OECC where it has significant coverage through Muskeget Channel’s shallow water passage (COP Volume II, Section 5.2.1; Epsilon 2022a). A sparse to moderate distribution of living eelgrass was identified in one area of the OECC along the south shore of Cape Cod (COP Volume II, Section 5.2.2; Epsilon 2022a). Benthic faunal communities in the OECC and SWDA are typical for the region and vary according to habitat type along gradients in depth, hydrodynamic conditions, and substrate composition.



SWDA = Southern Wind Development Area

Figure 3.4-1: Geographic Analysis Area for Benthic Resources



SWDA = Southern Wind Development Area

Figure 3.4-2: Benthic Resources within the Geographic Analysis Area

Seafloor conditions within the SWDA are generally homogenous and dominated by sand and silt-sized sediments. These homogenous conditions were identified by multibeam echo sounding and side scan sonar imaging techniques that have been ground-truthed via benthic grab samples, underwater video, borings, and cone penetration tests, and further verified via historic grab sample and still photo data (Guida et al. 2017; Stokesbury 2013, 2014). Large, broad, well-defined areas of rippled bedforms and ripple scour depressions are located on the surface of the bathymetric highs, oriented northeast-to-southwest in the southeastern portion of the SWDA. Smaller groupings of ripple scour depressions are found in the northern and western portion of the SWDA, which provide the only relief as compared to the relatively flat seafloor that gradually slopes offshore. These features within the SWDA provide less than 3.2-foot relief, far smaller than sand waves in some other parts of the Atlantic Ocean that can stretch for hundreds of feet. Much of the OECC exhibits unconsolidated sediment soft-bottom habitat with low complexity; approximately 67 percent of video transects found mostly flat sand/mud, sand waves, and biogenic structures, while 27 percent found pebble-cobble bottom and 24 percent found shell aggregate bottom (BOEM 2021b). Sections of the OECC in the vicinity of Muskeget Channel contain special, sensitive, or unique resources habitat that consists of “hard/complex bottom,” a category that includes biogenic structures, hard-bottom, and complex seafloor (i.e., sand waves), as defined in the *2021 Massachusetts Ocean Management Plan* (Massachusetts Office of Coastal Zone Management 2021).

The applicant conducted surveys of epifauna and infauna along the OECC using underwater video transects and sediment grab samples, respectively. The majority of the video transect samples recorded bottom habitats with low complexity, mostly comprised of flat sand/mud, sand waves, and biogenic structure (COP Section 5.1.1, Volume II; Epsilon 2022a). Areas of shell aggregate, specifically common Atlantic slipper shell (*Crepidula fornicata*) reefs, were observed along the OECC in the northern Nantucket Sound. Several locations within Muskeget Channel contained coarse deposits and hard-bottom habitats consisting of pebble-cobble dominated substrate with sulfur sponge (*Cliona celata*) communities. The OECC would make landfall at Craigville Public Beach or Covell’s Beach in Barnstable. A sparse to moderate distribution of eelgrass exists in and around the Spindle Rock boulder pile near the landfall site (COP Volume I, Section 3.2.1; Epsilon 2022a). Surveys have revealed isolated human-made objects to be avoided in the OECC and one debris pile/possible shipwreck in the OECC, approximately 6.8 miles southwest of Covell’s Beach.

3.4.1.2 Biota

The benthic communities in the SWDA are representative of the communities within New England waters in depths from approximately 141 to 203 feet, which includes amphipods and other crustaceans, American lobster (*Homarus americanus*), crabs, gastropods, polychaetes, bivalves, sand dollars, burrowing anemones, brittle stars, sea squirts, tunicates, and sea cucumbers (BOEM 2014a; Provincetown Center for Coastal Studies 2005). These organisms are important food sources for many commercially important fish species. Benthic communities are present in the patches of sand ripples and small mega-ripples within the SWDA (COP Volume II, Section 2; Epsilon 2022a); however, within these variable mobile sand environments, fauna is often quite sparse (Jennings et al. 2013).

Drop-down video surveys of benthic epifauna from 2010 to 2013 indicated that the common sand dollar (*Echinarachnius parma*) was the most abundant species within the RI/MA Lease Areas, with this species occurring in approximately 70 percent of a total of 216 samples (SMAST 2016a). Sample results collected during the School for Marine Science and Technology (SMAST) surveys indicated hydrozoans and bryozoans were present in approximately 19 percent of the samples, while hermit crabs, euphausiids, sea stars, and anemones, combined, were present in 13 percent of samples (SMAST 2016a). The SWDA was sampled in 2016, 2018, and 2019 by the applicant with the single grab sample from 2016 containing a high abundance (62 percent) of polychaete worms, which, together with nematode worms and annelid worms, accounted for 83 percent of all individuals identified (COP Volume II, Section 5.1.3;

Epsilon 2022a). Analysis of the 16 grab samples from 2018 showed 90 percent of the total abundance was made up of annelid worms and arthropods, which also accounted for 65 percent of all unique taxa. Other phyla captured in these samples included Cnidaria, Echinodermata, Mollusca, Nematoda, Nemertea, Phoronida, and Sipuncula. Grab samples from the 2019 survey contained Arthropoda (66 percent) and Annelida (28 percent) with the highest abundance of the phyla, representing 94 percent of all organisms, with 51 percent of all organisms being identified as amphipods from the family Ampeliscidae (COP Volume II, Section 5.1.3; Epsilon 2022a).

Bedforms ranging in size from ripples up to sand waves have been identified locally along the OECC; larger bedforms are found in waters with fast-flowing tidal currents. Benthic fauna tend to be most dense in the trough between sand waves where organic matter accumulates, while mobile species such as amphipods are prevalent on the slope of the sand wave (COP Volume III, Section 6.5.1.2; Epsilon 2022a). Previous studies of the species composition within sand waves have found that species present tend to be robust filter feeders (e.g., bivalves) as opposed to more delicate deposit feeders (e.g., feather duster worms and sea cucumbers), which tend to be found within flatter sedimentary bedforms (COP Volume III, Section 6.5.1.2; Epsilon 2022a). Results from the 2017 towed video survey of the OECC showed that the Nantucket Sound area was dominated by amphipods, slipper limpets, whelks, sponges, polychaetes, and spider crabs. Communities within the Eastern Muskeget Channel were more varied, with sulfur sponge (*Cliona celata*), red beard sponge (*Microciona* sp.), and blue mussels (*Mytilus edulis*) making up most of the observed epifauna. South of the Muskeget Channel, flat sand, mud, and biogenic structures were inhabited by mostly sand dollars and some burrowing anemones (COP Volume III, Section 6.5.1; Epsilon 2022a). The dominant infaunal organisms along the OECC include nematodes, amphipods, polychaete worms, nut clams, and snails (e.g., slipper limpets, pyram shells, and dove snails) (COP Volume II, Section 5.1.1; Epsilon 2022a).

The conditions of benthic resources can be affected by many external factors, which could impact the habitat, abundance, diversity, community composition, and percent cover of benthic fauna and flora. Benthic resources in the geographic analysis area are subject to pressure from ongoing and future actions, such as climate change, commercial fishing using bottom-tending gear (e.g., dredges, bottom trawls, traps/pots), and sediment dredging, and the impacts on benthic resources will continue regardless of offshore wind energy development. There are limited data on trends related to impacts from non-Project-related activities within the SWDA and OECC, although larger trends within coastal New England likely apply to the entire geographic analysis area for benthic resources. Historical data for Centerville Harbor show a slow decline in eelgrass bed habitat since 1951 (MassDEP 2011). Similarly, New England horseshoe crab (*Limulus polyphemus*) stocks are in decline (ASMFC 2013). Although not considered benthic habitat, beaches may be used for spawning by benthic species such as horseshoe crab, and shoreline development could affect access to spawning areas, although such activities are prohibited from impacting the spawning beaches themselves (MA DMF 2016a, 2018). See Section 3.6, Finfish, Invertebrates, and Essential Fish Habitat, for additional information.

Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by the regulatory authorities, individual local municipalities, and NOAA affect benthic resources by modifying the nature, distribution, and intensity of fishing-related impacts, including those that disturb the seafloor (e.g., trawling, dredge fishing) (Section 3.9, Commercial Fisheries and For-Hire Recreational Fishing). Disturbance of benthic invertebrate communities by commercial fishing activities can affect community structure and diversity and limit recovery (BOEM 2019a), although this impact is less significant in sandy areas that are strongly influenced by tidal currents and waves (Nilsson and Rosenberg 2003; Sciberras et al. 2016). However, bottom trawling is noted as one of the most prominent sources of physical disturbance to soft-sediment benthic communities and habitats (Moyrs et al. 2021), while dredging of soft-bottom substrates for navigation results in localized short-term impacts on benthic resources that would recover relatively quickly from the disturbance (BOEM 2019a).

3.4.2 Environmental Consequences

Definitions of impact levels for benthic resources are described in Table 3.4-1.

Table 3.4-1: Impact Level Definitions for Benthic Resources

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

3.4.2.1 Impacts of Alternative A – No Action Alternative on Benthic Resources

When analyzing the impacts of Alternative A on benthic resources, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the existing conditions for benthic resources (Table G.1-1 in Appendix G, Impact-Producing Factor Tables and Assessment of Resources with Minor [or Lower] Impacts). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for benthic resources described in Section 3.4.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities that could affect benthic resources within the geographic analysis area are climate change, commercial fishing using bottom-tending gear, and sediment dredging (as briefly described in Section 3.4.1), and the impacts on benthic resources will continue regardless of offshore wind energy development. The rate and extent of these activities vary and are uncertain, but their impacts on benthic resources would likely be detectable through changes in various metrics including habitat structure and faunal abundance, diversity, and composition.

While the proposed Project would not be built under Alternative A, BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to continue to affect benthic resources, although the exact impacts would not be the same due to temporal and geographical differences.

Ongoing non-offshore wind activities that have the potential to shift the existing conditions of the benthic resources within the geographic analysis area include mining of marine minerals, renewable energy projects other than offshore wind (e.g., wave and tidal), offshore dredged material disposal, military activities, marine transport, and telecommunications cables. It is uncertain whether or to what extent any of these activities would be conducted within the geographic analysis area, but all have the potential for impacting benthic habitat physical features (e.g., topography) and community composition by virtue of various associated IPFs as described in Appendix G.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than Alternative B). Future offshore wind activities would affect benthic resources through the following primary IPFs.

Accidental releases: Construction of future offshore wind projects would contribute to an increased risk for hazardous materials spills, the release of trash, and marine debris. There would also be an increase in the risk of the release of invasive species and their associated impacts. Best management practices (BMP) for waste management and mitigation of marine debris would be required and would reduce this risk.

Accidental releases may increase as a result of future offshore wind activities. The risk of accidental releases would increase during all phases of offshore wind development but primarily during construction. The probability of accidental releases of hazardous materials, primarily hydrocarbon compounds, would be minimized by preventative measures during routine vessel operations, including fuel transfers, with spill response plans being in place to potentially help mitigate and reduce the impacts. In the event of an accidental release (e.g., small fuel spill), the contaminant could be transported, adhere to particulates in the water column, and eventually sink to the seafloor, possibly resulting in elevated sediment hydrocarbon concentrations but not likely at levels that would affect benthic communities. In most cases, the corresponding impacts on benthic resources within the geographic analysis area are unlikely to be detectable unless there is a catastrophic spill from ongoing activities (e.g., an accident involving a tanker ship). A large spill is very unlikely, given the typical fuel storage capacities of offshore wind project vessels and facilities (COP Volume II, Appendix A, Section A.8.2; Epsilon 2022a).

The 2,955 WTGs and ESPs under Alternative A collectively hold approximately 119 million gallons of fuel/fluids/hazardous materials contained in all offshore wind facilities. The risk of a release from any one of these structures would be low. Recent modeling within the RI/MA Lease Areas demonstrated that a release of 128,000 gallons is likely to occur no more often than once per 1,000 years, and a release of 2,000 gallons or less is likely to occur every 5 to 20 years (Bejarano et al. 2013). 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 are largely discountable.

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 likelihood of invasive species becoming established as a result of offshore wind activities would be very low, but the impacts of establishment of an invasive species on benthic resources could be strongly adverse, widespread, and permanent. 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 from vessels may occur primarily during construction but also during operations and decommissioning. BOEM assumes all vessels would comply with laws and regulations to minimize accidental releases. Heavier, non-buoyant solid waste would sink and could accumulate on the seafloor, where it may eventually be colonized by epibiota. Seafloor debris may leach chemicals and potentially cause localized changes in benthic communities. There is no indication that the anticipated volumes and extents of accidental releases of solid waste within the geographic analysis area would have detectable impacts on benthic resources.

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

Anchoring and gear utilization: Ongoing and planned offshore wind activities are likely to include monitoring surveys in the offshore wind lease areas. These could include video, multibeam bathymetry, and grab samples, as well as other methods of sampling the biota in the area. The presence of monitoring gear could affect benthic resources through seafloor disturbance; however, it is expected that monitoring plans would have sufficient mitigation procedures in place to reduce potential impacts. Impacts from gear utilization from other offshore wind activities on benthic resources are likely to occur at short-term, regular intervals over the lifetime of the projects and have no perceptible consequences to individuals or populations. The future offshore wind scenario would lead to increased vessel anchoring during survey activities and construction, operations, and decommissioning stages. In addition, anchoring/mooring of meteorological (met) towers or buoys could increase. Benthic disturbance would occur from the contact of the anchor to the seabed and anchor drag, as well as anchor rigging (chains, cables, ropes). Anchoring activities disturb local sediments and benthic communities during emplacement. BOEM estimates that 1,031 acres of seabed could be impacted by deployed anchors associated with Alternative A. All impacts from anchoring would be localized, sediment disturbance would be temporary, and benthic resource recovery from impacts (including mortality) would occur in the short term. Degradation of sensitive habitats, such as eelgrass beds and hard-bottom habitats, if it occurs, could be long term to permanent. Impacts from anchoring would affect a relatively limited extent of the geographic analysis area and would be discontinuous in nature. Greater impacts on benthic resources would occur if impacts on sensitive habitats are not avoided.

Cable emplacement and maintenance: Emplacement of offshore submarine cables would cause short-term disturbance of seafloor habitats and injury and mortality of benthic resources in the immediate vicinity of the cable emplacement activities. The cable routes for future projects have not been fully determined at this time. Cable emplacement for other future offshore wind projects within the geographic analysis area would occur over from 2022 through 2030 and beyond and would disturb up to 5,898 acres, approximately 5 percent of available habitat in the geographic analysis area. Moreover, most disturbance would be expected to occur in sand bottom habitat (The Nature Conservancy 2014). Increased localized turbidity would occur during cable emplacement activities. Seafloor disturbance for other future offshore wind projects may affect benthic resources. Assuming future projects use installation procedures similar to those proposed in the proposed Project COP (Volume III, Section 2.2.1; Epsilon 2022a), the duration and extent of impacts would be limited and short term, and soft-bottom benthic assemblages would recover from the disturbance. If routes intersect eelgrass or hard-bottom habitats, impacts may be long term to permanent. Some types of cable installation equipment use water withdrawals, which can entrain planktonic larvae of benthic fauna (e.g., larval polychaetes, mollusks, and crustaceans) with an assumed 100 percent mortality of entrained individuals (COP Volume III, Section 6.5.2.1; Epsilon 2022a). Due to the surface-oriented intake of such methods, water withdrawal could also entrain pelagic eggs and larvae but would not directly affect resources on the seafloor. However, the rate of egg and larval survival to adulthood for many species is very low (MMS 2009). Due to the limited volume of water withdrawn (up to 1,200 million gallons), BOEM does not expect population-level impacts on any benthic species due to entrainment.

When cable emplacement and maintenance causes resuspension of sediments, increased turbidity could affect filter-feeding fauna such as bivalves. Most of the geographic analysis area for benthic resources is soft-bottom habitat comprised predominantly of sand that would settle out of the water column quickly, making increased turbidity brief. The impact of turbidity on benthic fauna depends on both the concentration of suspended sediment and the duration of exposure. For example, mollusk eggs do not experience sub-lethal impacts until an exposure of 200 milligrams per liter for 12 hours; for other life stages, 24 hours of exposure is the minimum threshold for sub-lethal impacts (Wilber and Clarke 2001). Modeling for the proposed Project predicted that suspended sediment should usually settle well before 12 hours have elapsed—typically between 1 to 6 hours (COP Volume III, Appendix III-A; Epsilon 2022a). Applying this finding to other offshore wind projects, relatively little impact from increased turbidity (separate from the impact of sediment deposition) is expected. Under Alternative A, the extent of sediment transport would be limited and spatially discontinuous due to cable emplacement and maintenance.

If the sediment disturbed by construction activities contains elevated levels of toxic contaminants, sediment disturbances could affect water quality and the physiology of benthic organisms. Consistent with the findings for Vineyard Wind 1, contaminated sediments are not anticipated to be a problem in the geographic analysis area for benthic resources. Sediment core samples from within the nearby Lewis Bay found sediment contaminant levels were below levels of concern (MMS 2009).

All impacts included in this IPF would be localized. Turbidity would be present during construction for 1 to 6 hours at a time, and the possible mortality of benthic resources would be recovered in the short term (COP Volume III, Appendix III-A; Epsilon 2022a). Any necessary dredging prior to cable installation could also contribute additional impacts. Similar to other physical disturbance (e.g., anchoring), greater impacts on benthic resources would occur if cable emplacement does not avoid sensitive habitats.

Dredging and/or mechanical trenching used during cable installation can cause localized short-term impacts, including habitat alteration, injury, and mortality, on benthic resources through seabed profile alterations, as well as impacts through the sediment deposition and burial IPF. The level of impact from seabed profile alterations would depend on the time of year that such alterations occur, particularly in nearshore locations, and especially if they overlap with times and places of high benthic organism abundance. Locations, amounts, and timing of dredging for future offshore wind projects are not known at this time. The need for dredging depends on local seafloor conditions, assuming the area of such impacts is proportional to the length of cable installed. Dredging typically occurs only in soft-bottoms habitats, which are abundant in the geographic analysis area and quick to recover from disturbance, although full recovery of the benthic faunal assemblage may require several years (Boyd et al. 2005). 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, would have little impact on benthic resources in the geographic analysis area.

Cable emplacement and 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 (COP Appendix III-A; Epsilon 2022a). Sediment deposition can have adverse impacts on benthic resources, including smothering. Benthic organisms’ tolerance to being covered by sediment (sedimentation) varies among species. The sensitivity threshold for sediment deposition in demersal eggs (such as fish or squid eggs) is greater than 0.04 inch (1 millimeter) (Berry et al. 2011); the sensitivity threshold for shellfish varies by species but can be generalized as deposition greater than 0.79 inch (20 millimeters) (Colden and Lipcius 2015; Essink 1999; Hendrick et al. 2016). Smit et al. (2008) evaluated the significance of depositional thickness on impacts on benthic communities. Estimates from that study indicated median (50 percent) and low (5 percent) impact levels of 54 millimeters and 6.3 millimeters (2.1 and 0.2 inches) of sediment deposition, respectively. That is, 54 millimeters is the thickness estimated to affect 50 percent of the benthos in the study, and 6.3 millimeters affected 5 percent of the studied benthos.

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. Cables for other future offshore wind projects in the geographic analysis area would be emplaced between 2022 and 2030 and beyond (Appendix E). Locations, amounts, and timing of dredging for future offshore wind projects are not known at this time. Assuming the area of such impacts is proportional to the length of cable installed, increased sediment deposition may occur during multiple years. The area with a greater sediment deposition from simultaneous or sequential activities would be limited, as most of the impacted areas would only have relatively light sediment deposition (less than 0.04 inch [1 millimeter]) and would recover naturally in the short term. If any dredged material disposal during construction occurs in the geographic analysis area, the activity would cause localized, temporary turbidity increases and sediment deposition or burial of benthic organisms at the immediate disposal site. The impacts of sediment deposition and burial on benthic resources within the geographic analysis area would be greater if sensitive habitats are not avoided.

Climate change: Benthic resources may be affected by climate change, including ocean acidification and warming, sea level rise, and altered habitat/ecology. Ocean acidification caused by atmospheric carbon dioxide (CO_2) may contribute to reduced growth or the decline of benthic resources with a calcareous structural component (Hoegh-Guldberg and Bruno 2010; PMEL 2020). Examination of 20 years (1990 to 2010) of occurrence and abundance data of soft-bottom benthic invertebrates along the Atlantic coast of the United States showed range shifts, most notably to the north, in response to rising water temperatures, resulting in changes to benthic community structure and function (Hale et al. 2017). Warming of ocean waters is expected to influence the distribution and migration of benthic resources and may influence the frequencies of various diseases (Brothers et al. 2016; Hoegh-Guldberg and Bruno 2010). Temperatures are predicted to continue to rise in the region, so these trends associated with warmer seawater is likely to continue, leading to changes in the distributions of some benthic species (Powell et al. 2020). Impacts on benthic resources through this IPF would be practically the same in the expanded planned activities scenario as they would be with only ongoing activities. See Section G.2.1, Air Quality, for details on the expected contribution of offshore wind development to climate change. Climate change is having notable and measurable impacts on regional benthic resources.

Discharges/intakes: Alternative A would increase the potential for discharges from vessels during construction, operations, and decommissioning. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. Discharges would particularly increase during construction and decommissioning, and the discharges would be staggered over time and localized. No available evidence indicates that the anticipated volumes and extents of discharges would affect benthic resources.

Electromagnetic fields (EMF): EMF, principally magnetic fields, would emanate from operating offshore wind facility transmission cables and existing cables connecting Nantucket and Martha's Vineyard to mainland Massachusetts. Under Alternative A, up to 1,253 miles of offshore export, inter-array, and inter-link cables would be added by projects in the RI/MA Lease Areas (except for the proposed Project), resulting in EMF in the immediate (less than approximately 33 feet) vicinity of each cable (CSA Ocean Sciences Inc. and Exponent 2019). Submarine power cables in the geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to very low levels. Wherever a cable is not buried or is closer to the aerobic surficial sediments (i.e., with shallow burial), 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 between cables (even for multiple cables within a single OECC), EMF strength diminishes rapidly with distance, and detectable, potentially meaningful EMF would likely extend less than 50 feet from each cable (McCormick et al. 2008). Some benthic species can detect EMF, although EMF does not appear to present a barrier to animal movement. Burrowing infauna may be exposed to stronger EMF, but little information is available regarding the potential consequences. For example, BOEM’s search of the available literature revealed no documented long-term impacts from EMF on clam habitat as a result of the existing power cables connecting Nantucket Island to mainland Massachusetts. There is little to no information on the EMF sensitivity of any taxa that are not commercially important. EMF at the levels expected from marine renewable energy activity is considered unlikely to impact receptive species (Copping et al. 2016; CSA Ocean Sciences Inc. and Exponent 2019; Gill and Desender 2020).

During operations, powered transmission cables would produce heat (Taormina et al. 2018). Studies of heat from buried cables have estimated that temperatures directly above a cable could rise by approximately 0.3 degrees Fahrenheit [°F]) in sediment and by 0.00001 °F in the water, which is insignificant (RI-CRMC 2010) and not anticipated to affect benthic fauna (Taormina et al. 2018).

Noise: Noise from construction, pile driving, geological and geophysical (G&G) survey activities, operations, and trenching/cable burial could contribute to impacts on benthic resources. The most impactful noise is expected to result from pile driving, which would occur during installation of foundations for offshore structures. 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 two foundations per day. One or more projects may install more than one foundation per day, either sequentially or simultaneously. Construction of offshore wind facilities in the geographic analysis area would likely occur from 2022 through 2030 and beyond, and pile-driving may occur year-round (excluding January through April). Little current research exists regarding the impacts of and sensitivity of benthic resources to underwater noise, including both sound pressure and particle motion (Roberts et al. 2016a; Roberts and Elliott 2017; Popper and Hawkins 2018). Nonetheless, marine invertebrates are expected to be sensitive to underwater noise and vibrations and may experience behavior changes, signs of physiological stress, injury, or mortality when noise or vibration levels exceed background levels such as in the presence of pile driving (Nedelec et al. 2014; Solan et al. 2016; Roberts and Elliott 2017). Noise transmitted through water and/or through the seabed is assumed to have the potential to cause injury and/or mortality to benthic resources in a limited area around each pile and cause short-term stress and behavioral changes to individuals over a greater area. The extent of these impacts would depend on pile size, hammer energy, and local acoustic conditions, as well as benthic resource sensitivity, which is unknown. The affected areas would likely be recolonized in the short term. Noise from pile driving that causes behavioral changes could affect the same populations or individuals multiple times in a year or in sequential years. The difference in impacts on benthic faunal resources between sequential or concurrent pile driving is unknown.

Noise from G&G surveys of cable routes and other site characterization surveys for offshore wind facilities could also disturb benthic resources in the immediate vicinity of the investigation and cause temporary behavioral changes. G&G noise would occur intermittently from 2022 through 2030 and beyond. G&G noise resulting from offshore wind site characterization surveys is less intense than G&G noise from seismic surveys used in oil and gas exploration; while seismic surveys create high-intensity impulsive noise to penetrate deep into the seabed, offshore wind site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves for shallow penetration of the seabed. Seismic surveys are not expected in the geographic analysis area for benthic resources. Detectable impacts of G&G noise on benthic resources would rarely, if ever, overlap from multiple sources but may overlap with behavioral impacts of pile-driving noise. Overlapping sound sources are not anticipated to result in a greater, more intense sound; rather, the louder sound prevents the softer sound from being detected.

Noise from trenching/cable burial 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 cable emplacement and maintenance and sediment deposition and burial IPFs. Noise from construction activities other than pile driving may occur; however, little of that noise propagates through the water, and 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. At least two projects are contemplating use of expanded or modified ports in Vineyard Haven, New Bedford, and Montauk. It is likely that other east coast ports will be upgraded with some expansion attributable to supporting the offshore wind industry. The increase in vessel traffic associated with offshore wind would be at its peak during construction activities, would decrease during operations, and would increase again during decommissioning. In addition, any port expansion and construction activities related to the additional offshore wind projects would add to the total amount of disturbed benthic area, resulting in mortality of individuals and temporary to permanent habitat alteration. Future port projects would likely implement BMPs to minimize impacts (e.g., stormwater management, turbidity curtains). Impacts on benthic resources would likely be undetectable outside the immediate vicinity of port expansion activities, except near Vineyard Haven, which is within the geographic analysis area.

Presence of structures: The presence of structures from future offshore wind projects can affect 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. Future offshore wind projects would include up to 474 WTG and ESP foundations, 1,149 acres of new scour protection for foundations, and 993 acres of hard protection for cables (Appendix E). In the geographic analysis area, structures are anticipated predominantly on sandy bottom, except for cable protection, which is most likely to be needed where cables pass through hard-bottom habitats. Projects may also install more buoys and met towers. Structures would be added intermittently from 2022 through 2030 and that they would remain until decommissioning of each facility is complete. The potential locations of cable protection for future actions have not been determined at this time. Although the glacial moraine and till that broadly extends from Montauk through Block Island, Martha’s Vineyard, and Nantucket exhibits areas of gravel, cobble, and boulders, large hard structure (greater than 3 feet high) is rare in the geographic analysis area, primarily limited to a few rock outcrops (e.g., Spindle Rock) and human-made piles near shore; therefore, structure additions by future offshore wind activities would constitute a large change to the regional amount of large hard structures present.

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

Human-made structures, especially tall vertical structures such as foundations, alter local water flow (hydrodynamics) at a fine scale. The consequences for benthic resources of such hydrodynamic disturbances are anticipated to be undetectable to small, localized, and to vary seasonally. Specifically, the bed material found in the southern New England area is made up of coarse substrates such as pebbles, shells, and gravel, and local currents can move grain sizes on the order of 1 to 1.5 millimeters (0.04 to 0.05 inch), which is smaller than the average local substrate. Addition of foundation from offshore wind structures was found to change the grain size that can be moved by +/- 0.3 millimeter (0.01 inch). Therefore, the predominant seabed sediments in the area would likely not be affected by the changes in the bed shear stress in average conditions due to the introduction of the offshore wind structures (Johnson et al. 2021).

Structures, including tower foundations, scour protection around foundations, and various means of protection atop cables create hard substrate with vertical relief in a mostly sandy seascape. Structure-oriented fishes would be attracted to these locations, which create reef-like habitats

(Mavraki et al. 2021). Increased predation upon benthic resources by structure-oriented fishes could affect benthic communities in the immediate vicinity of the structure. Additionally, the structures associated with future offshore wind projects may influence the conduct of fishing using bottom-tending gear within the geographic analysis area. The presence of wind farm structures may preclude use of towed bottom-tending gear (e.g., dredges, trawl nets) and could lead to increasing fishing pressure elsewhere (Section 3.9; Dannheim et al. 2020). These impacts are expected to be local and present as long as the structures remain.

The presence of structures would result in new hard surfaces that provide new habitat for hard-bottom species (Daigle 2011), including blue mussels and sea anemones, as seen at the Block Island Wind Farm (HDR 2020a; Kerckhof et al. 2019). Offshore wind structures can span the entire water column and introduce intertidal habitat where previously there was none. These new surfaces could also be colonized by invasive species (e.g., certain tunicate species) found in hard-bottom habitats on Georges Bank (USGS 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 (Greene et al. 2010; Guida et al. 2017). The potential impacts of wind farms on offshore ecosystem functioning have been studied using simulations calibrated with field observations (Pezy et al. 2018; Raoux et al. 2017; Wang et al. 2019). These studies found increased biomass for benthic fish and invertebrates and indicate that offshore wind farms can generate beneficial impacts on the local benthic communities. However, some impacts, such as the loss of soft-bottom habitat, may be adverse. The presence of structures would effectively convert the existing sand-bottom habitats at these locations into a hard-bottom habitat. Additionally, 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). These changes resulting from structure introductions and the loss of soft-bottom habitat may have impacts on benthic resources. The impacts on benthic resources would be present as long as the structures remain.

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 (e.g., trawling, dredge fishing). Offshore wind development could influence these regulated activities, possibly indirectly influencing when, where, and to what degree fishing activities affect benthic resources (Section 3.9). Fishing, in particular the use of bottom-tending gear, would impact benthic resources where such activities are permitted to occur. To the degree that offshore wind development results in regulatory exclusion of some currently fished areas from future fishing, Alternative A would eliminate impacts on those areas.

Conclusions

Impacts of Alternative A. Under Alternative A, benthic resources would continue to follow the current regional trends described in Section 3.4.1 and 3.4.2.1 and respond to both ongoing and future offshore wind activities.

While the proposed Project would not be built under Alternative A, ongoing activities would have continuing temporary to permanent impacts (disturbance, injury, mortality, habitat degradation, habitat conversion) on benthic resources primarily through anchoring and gear utilization, cable emplacement and maintenance, pile-driving noise, the presence of structures during operations of future offshore facilities (i.e., cable protection and foundation scour protection), port utilization near Vineyard Haven, climate change, and ongoing seafloor disturbances caused by sediment dredging and fishing using bottom-tending gear. Throughout the geographic analysis area for benthic resources, the impacts of ongoing activities, especially seafloor disturbances caused by sediment dredging and fishing using bottom-tending gear, would be **moderate**. Planned activities other than offshore wind including increasing vessel traffic; increasing construction; marine surveys; marine minerals extraction; port expansion; channel deepening activities; and the installation of new towers, buoys, and piers would result in **minor** impacts. The combination of ongoing and planned activities would result in **moderate** impacts on benthic resources, primarily driven by ongoing dredging and fishing activities.

Cumulative Impacts of Alternative A. Under Alternative A, existing environmental trends and ongoing activities would continue, and benthic resources would continue to be affected by natural and human-caused IPFs. Planned activities, including offshore wind would contribute considerably to several IPFs, primarily cable emplacement and maintenance and the presence of structures, namely foundations and scour/cable protection. Considering all the IPFs together, the cumulative impacts of Alternative A would result in **moderate** adverse impacts and could potentially include **moderate** beneficial impacts.

3.4.2.2 Relevant Design Parameters and Potential Variances in Impacts

The following primary proposed Project design parameters (Appendix C, Project Design Envelope and Maximum-Case Scenario) would influence the magnitude of the impacts on benthic resources:

- The number of vessels used during construction, operations, and decommissioning would potentially increase the risk of various IPFs (e.g., anchoring and gear utilization, accidental releases), resulting in increased potential impacts on benthic resources.
- The number of WTGs and ESPs and the amount of cable laid determines the area of seafloor disturbance and benthic resource exposure from installation. The area affected by WTGs is proportional to the number of WTGs installed. The benthic resources affected could differ depending on where the WTG and ESP are positioned within the geographic analysis area.
- Cable installation methods chosen, the amount of dredging, the duration of installation, and the chosen export cable routes (including variants within the OECC) would determine the type and number of benthic resources affected.
- Foundation type(s) used—namely monopiles, jackets, and bottom frame foundations (for Phase 2 only)—would change the level of benthic disturbance.
- The amount of scour/cable protection for the foundations, inter-array cables, and offshore export cables would alter the total amount of long-term habitat alteration. Less scour/cable protection would alter less habitat from soft-bottom to hard-bottom habitat.
- The time of year when foundation and cable installations occur can affect the level of benthic resource impacts. Potential impacts would have a greater magnitude if installation activities coincided with sensitive life stages for benthic organisms. Construction outside of the spring to summer window may have a lesser impact on benthic resources.

3.4.2.3 Impacts of Alternative B – Proposed Action on Benthic Resources

This section identifies the potential impacts of Alternative B on benthic resources. Except where otherwise stated, the impacts of Phase 1 decommissioning would be similar to those for Phase 1 construction for all of the IPFs described below.

Impacts of Phase 1

Construction of Phase 1 would affect benthic resources through the following primary IPFs during construction, operations, and decommissioning.

Accidental releases: As discussed in Section 3.4.2.1, non-routine events such as hazardous materials spills can have adverse or lethal impacts on marine life, including benthic resources. The risk of any type of accidental release would be increased primarily during construction or decommissioning but may also occur during operations of offshore wind facilities. Hazardous materials consist primarily of fuels, lubricating oils, and other petroleum compounds that tend to float in seawater; consequently, they are unlikely to contact benthic resources in most cases. For example, spills of sufficient size to reach shore could affect intertidal and shallow subtidal benthic resources via adsorption and sinking. Small spills would likely be unmeasurable and have a **negligible** impact on benthic resources. A large spill is unlikely, given the fuel storage capacities of proposed Project vessels and the safeguards to prevent spills from the WTGs, along with cleanup measures in place should a large spill occur, but could have a more significant impact on benthic resources due to impacts on water quality (Section G.2.2, Water Quality) and the potential for sinking and subsequent exposure of benthic resources.

Accidental releases of trash and debris are discussed in Section 3.4.2.1. Phase 1 construction would likely have no impact on benthic resources through the accidental release of trash and debris. In addition, accidental releases of invasive species could affect benthic resources if the invasive species become(s) established and out-compete(s) native fauna; the risk of this type of release would be increased by the additional vessel traffic associated with Phase 1 during construction. The potential impacts on benthic resources are described in Section 3.4.2.1. The increase in the risk of accidental releases of invasive species attributable to Phase 1 construction would be small in comparison to the risk from ongoing activities.

The risk of accidental releases of oil or chemical spills from monitoring and maintenance vessels is lower during operations due to the reduction of vessels used for this stage, compared to the construction or decommissioning stage. Small spills would likely be unmeasurable and have a **negligible** impact on benthic resources. A large spill is very unlikely given the fuel storage capacities of proposed Project vessels but could have a more significant impact on benthic resources due to impacts on water quality (Section 3.4.2.1), the potential for sinking within shallow marine benthic environments, and high-volume direct contact with fouling communities.

The impacts of accidental releases during Phase 1 decommissioning would be similar to construction: localized, temporary, and **negligible**.

Anchoring and gear utilization: Monitoring survey methods for Alternative B may include video, multibeam bathymetry, and grab sampling. As described in Section 3.4.2.1, survey gear could affect benthic resources through seafloor disturbance. Because the applicant would develop monitoring plans in coordination with BOEM, other federal and state agencies, other offshore wind developers, and other stakeholders (COP Volume I, Section 4.1.3; Epsilon 2022a), BOEM assumes that survey procedures would have sufficient mitigation procedures in place to reduce potential impacts including, but not limited to, avoidance of sensitive benthic habitats. Therefore, impacts on benthic resources from monitoring surveys would be negligible based upon the limited extent and frequency of surveys and the short duration of sampling events.

Construction would be conducted from vessels utilizing spuds, jack-up legs, anchors, dynamic positioning, and securing to existing structures; therefore, limited anchoring would occur. The amount of seabed disturbance from jack-up, anchored vessels, cable installation, and metocean buoy anchors would be up to 421 acres as stated in the COP (Volume III, Section 6.5.2.1.1). The potential impacts on benthic resources from anchors, anchor drag, and rigging (chains, cables, ropes), nearshore intentional vessel groundings, spuds, or jack-up vessels include crushing of benthic fauna and disturbance of physical habitat structure. Impacts on benthic resources are greatest for sensitive benthic habitats (e.g., eelgrass beds, hard-bottom habitats). As discussed in Section 3.4.2.1, degradation of sensitive habitats, such as eelgrass beds and hard-bottom habitats, if it occurs, could be long term to permanent. The relatively limited extent and spatial discontinuity of impacts from anchoring and gear utilization within the geographic analysis area is estimated to be **minor** on benthic resources if sensitive habitats are avoided and **moderate** if sensitive habitats are not avoided. The impacts of anchoring during Phase 1 decommissioning would be similar to construction: **minor** to **moderate**.

Cable emplacement and maintenance: Despite unavoidable mortality, injury/damage, or displacement of benthic invertebrate organisms, the area affected by the 278 acres of temporary cable emplacement footprint in the offshore proposed Project area (COP Volume III, Appendix III-T; Epsilon 2022a) would be 0.2 to 0.3 percent of the SWDA (101,590 to 111,939 acres). The SWDA is comprised entirely of unconsolidated substrate, predominantly sand and mud (soft bottom). The seafloor would be disturbed by cable trenches, skid tracks, and spud prints. Although active construction would temporarily disturb benthic habitat, non-complex habitats would rapidly return to pre-Project conditions following impacts from burial. The fine- and medium-grained sand of the SWDA provides uniform and simple (non-complex) habitat for benthic infaunal organisms typical of this region. Sand waves are present in the OECC (COP Volume III, Section 6; Epsilon 2022a), and disturbance of sand waves would be temporary, given that sand waves are ephemeral, mobile features. Complex habitats may take longer to recover but would still recover completely (HDR 2020a). The impacts would likely be short term, considering the natural mobility of sand in the SWDA and OECC, although full recovery of the benthic faunal assemblage may require several years (Boyd et al. 2005). Population-level impacts are not expected to occur for benthic species (i.e., generally accepted ecological and fisheries methods would be unable to detect a change in population) as a result of Phase 1. Neighboring benthic communities that have similar habitats and assemblages would colonize disturbed areas over time that have not been displaced by new structures.

The cable would be buried using a jet trench, trench former, chain cutting, hydroplow, mechanical trenching plow, or a mechanical cutter to create a trench along the seabed; all are mechanisms in which the cable is simultaneously laid and buried in a single pass. Cable burial would result in an increase in suspended sediments and an increase in the water content of seafloor sediments (i.e., the ratio of liquid to solid mass) within the trench. Predictive modeling indicates that most of the sediments settle out quickly and are not transported for long by the currents (COP Volume III, Appendix A; Epsilon 2022a). Sediment deposition greater than 1 millimeter is generally confined within 328 to 492 feet of the installation alignment with maximum deposition usually less than 5 millimeters (COP Volume III, Appendix A; Epsilon 2022a). In areas where displaced sediment results in thick deposition, organisms may be smothered, which would result in mortality. Smit et al. (2008) evaluated the significance of depositional thickness on benthic community impacts with median (50 percent) and low (5 percent) effect levels of 54 millimeters and 6.3 millimeters of sediment deposition, respectively. Since most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occurs naturally, impacts on benthic resources would be **minor**.

As the export cables approach the shoreline, the ocean-to-land transition at the selected landfall sites would be made using HDD, which would avoid or minimize impacts on the beach, intertidal zone, and nearshore areas and achieve a burial significantly deeper than any expected erosion. Therefore, **negligible** impacts on benthic resources would occur from the landfall transition.

During cable emplacement and installation, pre-construction grapnel runs would extend beyond the area affected by cable emplacement, which could lead to short-term impacts including habitat alteration, injury, and mortality. Much of the offshore proposed Project area is characterized as unconsolidated soft sediment arranged in waves, megaripples, and ripples, with some isolated patches of mud and gravel. These features would temporarily be disturbed by pre-construction grapnel runs; seabed preparation; possible sand wave dredging; foundation placement; scour protection installation; anchoring, clearing, and trenching for offshore export and inter-array cable installation; and cable protection activities. Sand ripples and waves disturbed by offshore export and inter-array cable installation would naturally reform within days to weeks under the influence of the same tidal and wind-forced bottom currents that formed them initially (Kraus and Carter 2018). The seabed profile alterations are expected to recover without mitigation; therefore, the impacts would be **minor**.

Overall, the impacts from cable emplacement and maintenance are expected to be notable and measurable, but resources would recover completely without remedial or mitigation action; impacts on benthic resources from the proposed Project are, therefore, expected to be **minor** if sensitive habitats are avoided and **moderate** if sensitive habitats are not avoided.

Although construction would have the greatest impact on benthic resources, the maintenance of these cables would also result in potential impacts, specifically when cable repairs are required or cable protection is added. Cable protection would be needed where cable burial desired depth is not feasible. Methods of cable protection would include rocks, gabion rock bags, or concrete mattresses. The applicant estimates approximately 6 percent of the offshore export cables and approximately 2 percent of inter-array and inter-link cables would require cable protection due to insufficient burial depth, totaling approximately 266 acres of hard protection. Recovery rates of these disturbed surfaces would depend on the species present and their recovery capabilities and would result in **minor** to **moderate** impacts depending on the location of the maintenance. The impacts of cable removal during Phase 1 decommissioning would be similar to construction: **minor** to **moderate**.

Climate change*:* The surveying, construction, and decommissioning activities associated with Phase 1 would produce GHG emissions that can be assumed to contribute to climate change; however, these contributions would be minute (i.e., 6,990 metric tons) compared with aggregate global emissions. The impact of GHG emissions on benthic resources from the proposed Project would not be detectable and would, therefore, be **negligible**.

Phase 1 operations would marginally reduce or displace emissions from conventional power generation, thereby contributing to slowing or arresting global warming and associated climate change and having a long-term and **negligible** beneficial impact on benthic resources. Other future offshore wind projects would have similar beneficial impacts but on a larger scale (although the combined offshore wind projects would still displace a small share of global emissions). The impacts of Phase 1 decommissioning on GHGs would be similar to construction: temporary and **negligible**.

Discharges/intakes: The increase in vessel traffic for construction and increases the volume of discharges to the receiving waters, including bilge, wastewater, ballast, deck drainage, fire suppression system test water, condensate, and seawater cooling effluent, among others. This increase in discharges for Phase 1 activities is not anticipated to affect benthic resources and would have **negligible** impacts. Similarly, impacts from discharges and intakes during Phase 1 operations and decommissioning would have **negligible** impacts on benthic resources.

EMF: As discussed in Section 3.4.2.1, EMF production during the operation of power transmission cables can be detected by some benthic species but does not appear to present a barrier to movement. EMF impacts would be minimized by burying cables to the target depth of 5 to 8 feet below the seafloor. Little is known about the potential impacts of EMF on benthic resources, although the available information suggests that field strengths expected from Phase 1 would be below levels shown to cause impacts (Section 3.4.2.1). Therefore, the impacts on benthic resources from EMF would be **negligible** during operations.

Noise*:* Phase 1 would result in construction-related noise from G&G surveys, vessel traffic, WTG installation, pile driving, and cable burial. The nature of these sub-IPFs and of their impacts on benthic resources are described in Section 3.4.2.1. Phase 1 would produce noise from pile driving during installation of up to 63 foundations for approximately 2 to 3 hours per foundation or 4 to 6 hours per day for the installation of two foundations per day (COP Volume III, Section 6.3.7). This noise would occur intermittently for up to 62 days between May and December. Technical details related to pile-driving noise are analyzed for demersal and benthic fishes and commercially important invertebrates in Section 3.6. Limited research exists regarding the impacts of and sensitivity of benthic resources to underwater noise, including both sound pressure and particle motion. A recent summary of knowledge on how offshore wind activities affect the benthic environment indicated that the impact of sound on epibenthos is poorly understood and is generally lacking (Dannheim et. al. 2020). Popper and Hawkins (2018) describe that many acoustic studies only assess impacts from sound pressure and omit particle motion. This oversight increases the uncertainty in impact determination (Popper and Hawkins 2018). Marine invertebrates are likely sensitive to underwater noise and vibrations such as pile driving. Noise transmitted through water and/or the seabed is, therefore, assumed to have the potential to cause injury and/or mortality to benthic resources in a limited area around each pile and is assumed to cause short-term stress and behavioral changes to individuals over a greater area. Given that most benthic species in the region are either mobile as adults or planktonic as larvae, disturbed areas would likely be recolonized naturally.

The **negligible** (for most noises) to **moderate** (for pile-driving noise) impacts (disturbance, injury, and mortality) of Phase 1 on benthic resources would be in addition to the noise that would occur under Alternative A, which is expected to result in similar local temporary impacts. The most impactful noise is expected to come from pile driving.

The applicant is considering the use of a bubble curtain for far-field noise mitigation. The use of noise-reduction technologies during all pile-driving activities to achieve a minimum attenuation of 6 decibels (dB) would reduce the area of high noise levels during construction and subsequently minimize potential noise-related impacts on benthic resources. A bubble curtain system is a compressed air system (air bubble barrier) for sound absorption in water. Sound stimulation of air bubbles at or close to their resonance frequency effectively reduces the amplitude of the radiated sound wave by means of scattering and absorption effects. A bubble curtain functions as follows: air is pumped from a separate vessel with compressors into nozzle hoses lying on the seabed, and it escapes through holes that are provided for this purpose. Thus, bubble curtains are generated within the water column due to buoyancy. Noise emitted by pile-driving must pass through those ascending air bubbles and is attenuated. Bubble curtains are intended to minimize the potential impact of noise. However, the necessity of this mitigation for benthic resources is speculative since impact of sound on epibenthos is poorly understood and generally lacking (Dannheim et al. 2020). The overall impact on benthic resources from pile-driving activities under Phase 1 is uncertain and conservatively expected to be **moderate**.

Noise from trenching/cable burial is expected to occur but would have limited impact on benthic resources. Noise from trenching/burial of inter-array and export cables would be temporary, local, and extend only a short distance beyond the emplacement corridor. Cable-laying and trenching noise is expected to have no measurable impacts on benthic resources; impacts are expected to be **negligible**.

Noise impacts from Phase 1 decommissioning would be similar to construction, except that decommissioning would not involve pile driving. As a result, noise impacts during decommissioning would be **moderate.**

Port utilization: Because Phase 1 would cause no change in port utilization other than increased vessel traffic and use of already existing ports, Phase 1 port utilization would have **negligible** impacts on benthic resources during construction, operations, and decommissioning. Port facilities and staging areas are discussed further in Section G.2.7, Land Use and Coastal Infrastructure.

Presence of structures: The presence of structures can lead to impacts on benthic resources primarily through hydrodynamic disturbance, habitat conversion, entanglement and gear loss/damage, and displacement of fishing pressure. Phase 1 could result in up to 63 foundations (up to 2 of which would be

ESPs, with the remainder for WTGs) foundations, up to 74 acres of foundations and scour protection, and up to 13 acres of cable protection that could cause temporary to permanent impacts, as discussed in Section 3.4.2.1. Up to approximately 6 percent of the offshore export cable in the OECC and 2 percent of the export cables in the SWDA would be covered with cable protection material to ensure that they remain covered during storms and other events that disturb the seafloor (COP Volume III, Section 2.2.1; Epsilon 2022a).

Human-made structures alter local water flow (hydrodynamics) at a fine scale (Johnson et al. 2021). Once Phase 1 construction is complete, the presence of the WTG and ESP foundations would result in localized alteration of water column currents, which could produce sediment scouring and alter benthic habitats and dispersal patterns of planktonic larvae. However, the consequences of such hydrodynamic disturbances are anticipated to be countered by the placement of scour protection, resulting in **negligible**, localized, and seasonally variable impacts.

Phase 1 would alter the existing benthic habitat by adding hard surfaces, vertical relief, and habitat complexity, converting soft-bottom substrate to hard-bottom substrate. Depending on the material used, the scour/cable protection could produce a reef effect that would support a succession of hard-bottom benthic assemblages throughout the life cycle of the proposed Project in seafloor areas that are largely composed of unconsolidated sediments. As a by-product of hard-bottom community development, deposition of shell hash and other detritus is expected to build up around the monopile foundations (Causon and Gill 2018). Moreover, the presence of vertical structures in the water column creates turbulence that can transport nutrients upward toward the surface, increasing primary productivity at localized scales (Dannheim et al. 2020). These changes have been reported to increase food availability for filter-feeders on and near the structures, which, in turn, leads to increased densities of mobile invertebrates (e.g., crabs, lobsters), attraction of pelagic and demersal fish, and foraging opportunities for marine mammals (Coates et al. 2014; Dannheim et al. 2020; English et al. 2017). Conversely, these hard surfaces also provide additional attachment points for non-native species, eliminate soft-bottom habitat, and create organic enrichment that can be detrimental if it occurs in oxygen-deficient sediments (De Mesel et al. 2015; Wilding 2014). The presence of structures would increase long-term benthic habitat complexity for the duration of the proposed Project. The conversion of soft-bottom habitat to new hard-bottom habitat from the placement of scour/cable protection would have a localized impact on soft-bottom communities, while hard-bottom communities would benefit from the additional hard substrate. In general, this conversion of soft-bottom habitat to a more reef-like structure has potential **moderate** beneficial impacts on the surrounding biological community but also is expected to have **moderate** adverse impacts on the soft-bottom communities.

Regulated fishing can affect benthic resources by modifying the nature, distribution, and intensity of fishing-related impacts (mortality, bottom disturbance). Phase 1 construction and structures could affect when, where, and to what degree fishing activities affect benthic resources. For example, potential displacement of towed bottom-tending gear (e.g., dredges, trawl nets) could result in localized recovery of benthic assemblages. The changes in regulated fishing effort on benthic resources are uncertain but would likely result in **moderate** impacts on benthic resources, especially where bottom-tending gear is used. To the degree that offshore wind development results in regulatory exclusion of some currently fished areas from future fishing, Phase 1 would have **moderate** beneficial impacts on those areas.

The presence of structures would increase the risk of gear loss/damage by entanglement, as discussed in Section 3.4.2.1. The lost gear, moved by currents, could 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 are present, resulting in **minor** impacts.

The presence of structures impacts from Phase 1 construction would have **negligible** to **moderate** impacts and **moderate** beneficial impacts on benthic resources. Currently, there is minimal large hard structure outside coastal zones, so the addition of structures from Phase 1 and other offshore wind projects would constitute a significant change to existing conditions. The structures and the consequential impacts would remain until decommissioning is complete.

The impacts of the removal of Phase 1 structures during decommissioning would be similar to construction: **moderate** and **moderate** beneficial where bottom-tending gear use was discontinued during operations.

Impacts of Phase 2

As described in this section, impact levels for Phase 2 are expected to be similar to those of Phase 1 (Section 3.4.4.1) due to the use of similar construction and decommissioning techniques.

Phase 1 and Phase 2 construction would each result in a similar number of vessels performing similar operations, construction methods, and component infrastructure. Phase 2 would include up to 89 foundations (up to 3 of which would be ESPs, with the remainder for WTGs), and could potentially use bottom-frame foundations for WTGs and ESPs (COP Volume I, Section 4.2.1; Epsilon 2022a). As shown in Table C-3 in Appendix C, each bottom-frame foundation would require up to 1.7 acres of scour protection, compared to 1.2 acres for monopiles and 1.6 acres for each jacket foundation. As a result, Phase 2 impacts would be marginally larger than, but substantively similar to, those described for Phase 1 in Section 3.4.4.1.

If the applicant selects the SCV as part of the final Phase 2 design, some or all of the impacts on benthic resources from the Phase 2 OECC through Muskeget Channel may not occur[11], while impacts along the SCV route would occur. The SCV would disturb up to 329 acres of seafloor, including approximately 41 acres of offshore export cable protection, but impacts would be localized, short term, and temporary. Based on available information, the impacts of SCV construction on benthic resources would be similar to those for the Phase 1 OECC and range from **negligible** to **moderate**; impacts would be largest if special benthic habitats such as EFH cannot be avoided. BOEM will provide a more detailed analysis of the SCV impacts on benthic resources in a supplemental NEPA analysis.

Phase 2 operations would be similar to (and likely be combined with) Phase 1 and would, thus, result in **negligible** to **minor** impacts on benthic resources. Phase 2 decommissioning impacts are expected to be similar to those described for Phase 1 and would range from **negligible** to **moderate**.

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-1 in Appendix G would contribute to impacts on benthic resources through the primary IPFs of anchoring and gear utilization, cable maintenance, noise, and the presence of structures. These impacts would primarily occur through bottom-disturbing activities that directly affect benthic resources. The cumulative impacts of all IPFs from ongoing and planned activities, including Alternative B, would be **moderate,** with a **moderate** beneficial impact from the presence of structures until decommissioning.

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[11] The applicant would be required to notify BOEM of a COP revision pursuant to 30 CFR § 585.634 if the applicant determines the SCV is necessary.

Conclusions

Impacts of Alternative B. Alternative B would have **negligible** to **moderate** impacts on benthic resources within the geographic analysis area based on all IPFs, as well as **moderate beneficial** impacts from the presence of structures. Alternative B would affect benthic resources by causing temporary habitat disturbance; permanent habitat conversion; and behavioral changes, injury, and mortality of benthic fauna. Impacts from Alternative B would include temporary and long-term consequences resulting from habitat alteration, increased turbidity, sediment deposition, entrainment, increased noise, vessel strike, and EMF. The most prominent IPFs of Alternative B are expected to be cable emplacement and maintenance, presence of structures, noise (specifically from pile driving), and ongoing climate change (exclusive of Alternative B activities). In general, the impacts are likely to be local and not alter the overall character of benthic resources in the geographic analysis area. Despite mortality and temporary or permanent habitat alteration, the long-term impact on benthic resources from Alternative B would be **moderate**, as the impacts could be measurable on a site-level scale but not within the entire proposed Project area, and the resources would likely recover naturally over time. The applicant may elect to pursue a course of action within the PDE that would cause less impact than the maximum-case scenario evaluated above but doing so would not likely result in different impact ratings than those described above.

Cumulative Impacts of Alternative B. The cumulative impacts on benthic resources within the geographic analysis area would be **moderate**, as well as **moderate beneficial** from the presence of structures. As with Alternative B alone, the most prominent IPFs for cumulative impacts would be cable emplacement and maintenance, presence of structures, noise (specifically from pile driving), and climate change. Cumulative impacts would only occur where the activities of Alternative B overlap with other ongoing or planned activities (i.e., within the SWDA and OECC).

3.4.2.4 Impacts of Alternative C – Habitat Impact Minimization Alternative on Benthic Resources

Alternatives C-1 and C-2, summarized below, would limit the number of export cables installed in the Eastern Muskeget route or Western Muskeget Variant but would not affect the number or placement of WTGs or ESPs for the proposed Project, compared to Alternative B. All other proposed Project components including construction, operations, and decommissioning would be identical to Alternative B:

- Alternative C-1 would avoid impacts on complex habitats in the Western Muskeget Variant by removing that route as an option for Phase 2. Under this alternative, all three Phase 2 cables would be installed in the Eastern Muskeget route.
- Alternative C-2 would limit the number of export cables installed in the Eastern Muskeget route to three (two for Phase 1 and one for Phase 2) and include installation of up to two cables in the Western Muskeget Variant. This would reduce impacts on complex habitats in the Eastern Muskeget route.

Alternatives C-1 and C-2 would reduce or avoid impacts on benthic resources (compared to Alternative B) during construction, operations, and decommissioning in either the Western Muskeget Variant or Eastern Muskeget route. This would reduce the impacts from IPFs for anchoring and gear utilization, cable emplacement and maintenance, noise, and presence of structures in the specific area avoided.

The Western Muskeget Variant would affect less seafloor acreage than the Eastern Muskeget route; however, the Western Muskeget Variant is comprised of complex seafloor only, while the Eastern Muskeget route is comprised of complex seafloor, hard coarse deposits, and soft bottom (Table 3.4-2).

Table 3.4-2: Maximum Acres of Benthic Habitat Type: Western Muskeget Variant and Eastern Muskeget Route

Benthic Habitat Type	Western Muskeget Variant (acres)	Eastern Muskeget Route (acres)
Complex seafloor	861.3	777.8
Hard coarse deposits	0.0	159.9
Soft bottom	0.0	94.9
Total	861.3	1,032.6

Alternative C-1 would use only the Eastern Muskeget route, which would eliminate the impacts on benthic resources in the Western Muskeget Variant. The Eastern Muskeget route contains more types of benthic habitat than the Western Muskeget Variant, but less of the benthic habitat is complex seafloor. Using only the Eastern Muskeget in Alternative C-1 would, therefore, affect more benthic habitat types and a wider variety of benthic species inhabiting these habitats than if the Western Muskeget Variant alone were used. However, Alternative C-1 would affect less of the complex benthic habitat compared to Alternative B (which includes the potential use of the Western Muskeget Variant).

Alternative C-2 could use both the Eastern Muskeget route and the Western Muskeget Variant and, therefore, impact benthic resources in complex seafloor, hard coarse deposits, and soft bottom habitats across a larger area than Alternative C-1. Under Alternative C-2, dredging for Phase 2 cable installation could impact up to 73 acres and include up to 274,800 cubic yards of dredged material (compared to 67 acres and 235,400 cubic yards for Alternative B and Alternative C-1). The impacts of Alternative C-2 on benthic habitats in the Eastern Muskeget route would be less than Alternative C-1 and potentially less than Alternative B because Alternative C-2 would involve installation of fewer cables in the Eastern Muskeget route. The impacts of Alternative C-2 on benthic resources in the Western Muskeget Variant would be greater than Alternative C-1, due to the installation of up to two cables in that corridor (where no such cables would be installed under Alternative B or Alternative C-1). Overall, Alternative C-2 would have greater impacts on benthic resources in complex seafloor habitats due to impacts within both the Eastern and Western Muskeget.

Overall, the impacts of Alternatives C-1 and C-2 on benthic resources would remain **negligible** to **moderate**. Although Alternative C-1 would result in a slightly shorter cable route due to use of the Eastern Muskeget route only, compared to cable placement in both the Eastern Muskeget route and the Western Muskeget Variant, the differences in route length are not anticipated to be enough to reduce the potential impacts on benthic resources. The cumulative impacts of Alternatives C-1 and C-2 along with ongoing and planned activities, would be similar to those of Alternative B: **negligible** to **moderate** and **moderate** beneficial with the highest impacts occurring if sensitive benthic habitat cannot be avoided.

3.5 Coastal Habitats and Fauna

3.5.1 Description of the Affected Environment

3.5.1.1 Geographic Analysis Area

This section describes the existing conditions in the geographic analysis area for coastal habitats and fauna as described in Table D-1 in Appendix D, Geographical Analysis Areas, and shown on Figure 3.5-1. This involves all lands and waters that are within a 1-mile buffer of the OECC and that fall within the 3-nautical-mile (3.5-mile) seaward limit of Massachusetts' territorial sea to 100 feet landward of the first major land transportation route encountered (a road, highway, rail line, etc.).

Under Section 404 of the CWA, (33 USC § 1344), the USACE regulates the discharge of dredged or fill materials into the waters of the U.S. and has jurisdiction in tidal waters from the high tide line to the 3-nautical-mile (3.5-mile) limits of the territorial seas (33 CFR § 328.4). In addition, under Section 10 of the RHA, the USACE regulates construction located in or affecting "navigable waters of the U.S." Tidal, navigable waters extend from the mean high water line to the seaward limit of the OCS (43 USC § 1333[e] and 33 CFR § 320.2). Therefore, the geographic analysis area for coastal habitats and fauna includes the tidal portion of USACE jurisdiction under CWA Section 404, as well as work regulated under Section 10 from the mean high water line to the 3-nautical-mile (3.5-mile) seaward limit of territorial seas.

The Massachusetts Office of Coastal Zone Management (CZM) manages coastal habitats and fauna within the geographic analysis area. The coastal habitats within the geographic analysis area are limited to portions of the OECC, the potential landfall sites, and the potential onshore cable crossings of the Centerville River (COP Volume I, Figures 3.3-5a through 3.3-5d; Epsilon 2022a) and East Bay (COP Volume I, Figure 4.1-2; Epsilon 2022a). The SWDA and the southernmost portion of the OECC (approximately 14 miles) are beyond the seaward limits of the territorial seas of Massachusetts and Rhode Island. Section 3.6 provides a broader discussion of impacts on essential fish habitat (EFH), finfish, and invertebrates (including shellfish); Section 3.4 discusses benthic resources; Section G.2.6 discusses wetlands and other waters of the U.S.; and Section G.2.5 in Appendix G, Impact-Producing Factor Tables and Assessment of Resources with Minor (or Lower) Impacts, discusses terrestrial habitats and fauna.

3.5.1.2 Existing Resources

The potential Phase 1 landfall sites at Craigville Beach and Covell's Beach are in paved parking areas. Both Phase 1 landfall sites have been surveyed to identify sensitive nearshore habitats (COP Volume III, Section 6.4.1.1; Epsilon 2022a). An eelgrass [*Zostera marina*] bed growing in an area with a hard bottom, is present offshore of these potential landfall sites in the vicinity of Spindle Rock. Otherwise, these potential landfall sites are free of offshore eelgrass and other sensitive habitats in the nearshore area. The potential Phase 2 landfall sites at Dowses Beach and Wianno Avenue are also in paved areas and have also been surveyed to identify any sensitive nearshore habitats (COP Volume III, Section 6.4.1.1; Epsilon 2022a). The surveys identified a patch of eelgrass southwest of the OECC, suggesting the presence of an eelgrass bed and an area with complex habitat near the Dowses Beach Landfall Site.

The Centerville River estuary and East Bay contain soft-bottom habitats in areas of open water and also exhibit extensive areas of salt marsh near the shoreline. These connected bodies of water are known habitats for Quahog clams (*Mercenaria mercenaria*), and they also host spawning runs of river herrings. These bodies of water are currently listed as impaired by nutrient loading, partially caused by inadequate and failing septic systems (Cape Cod Commission 2017). The Town of Barnstable plans to mitigate this nutrient loading by expanding and upgrading municipal sewer systems over the next decade (Town of Barnstable 2020).

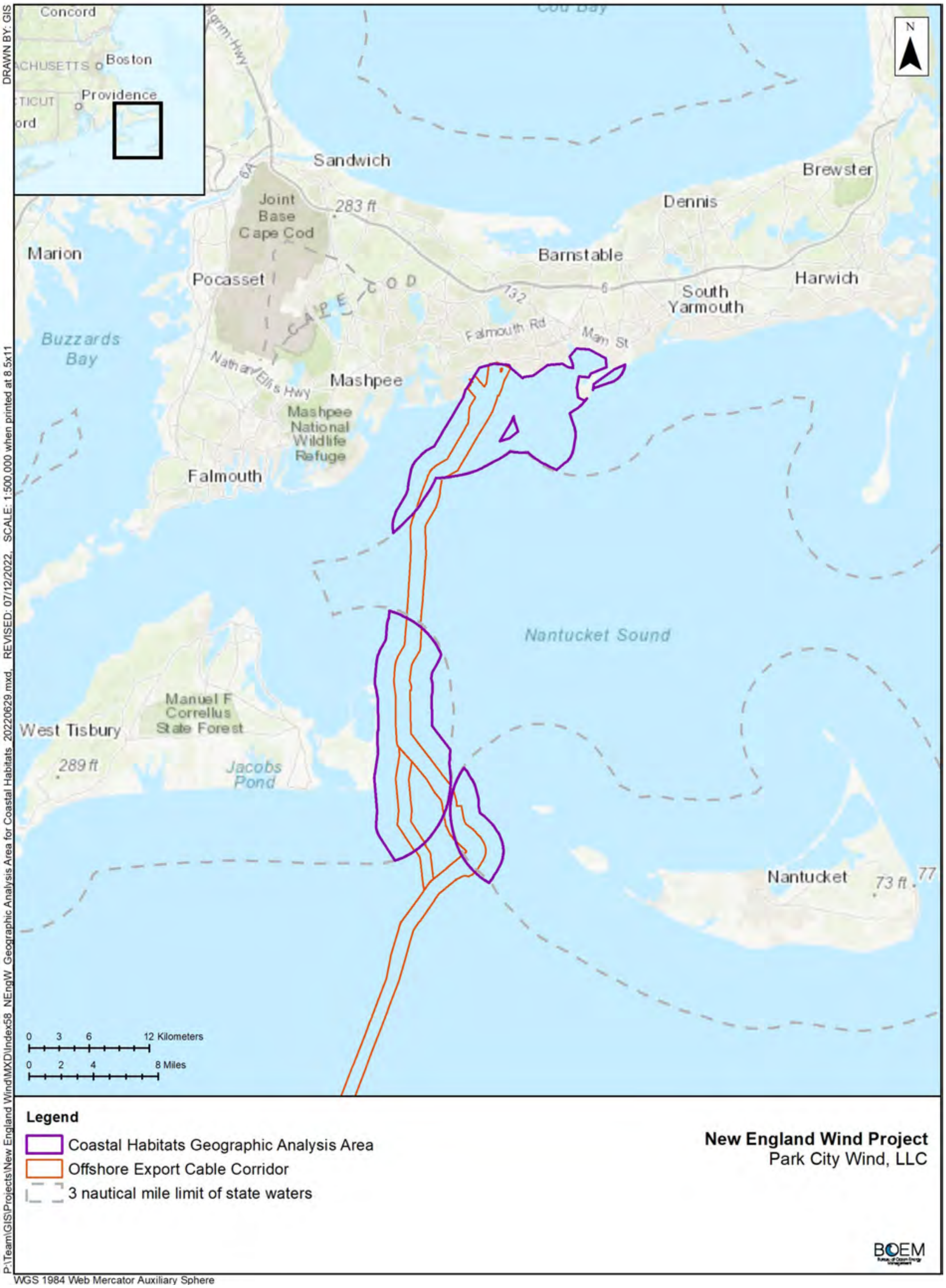
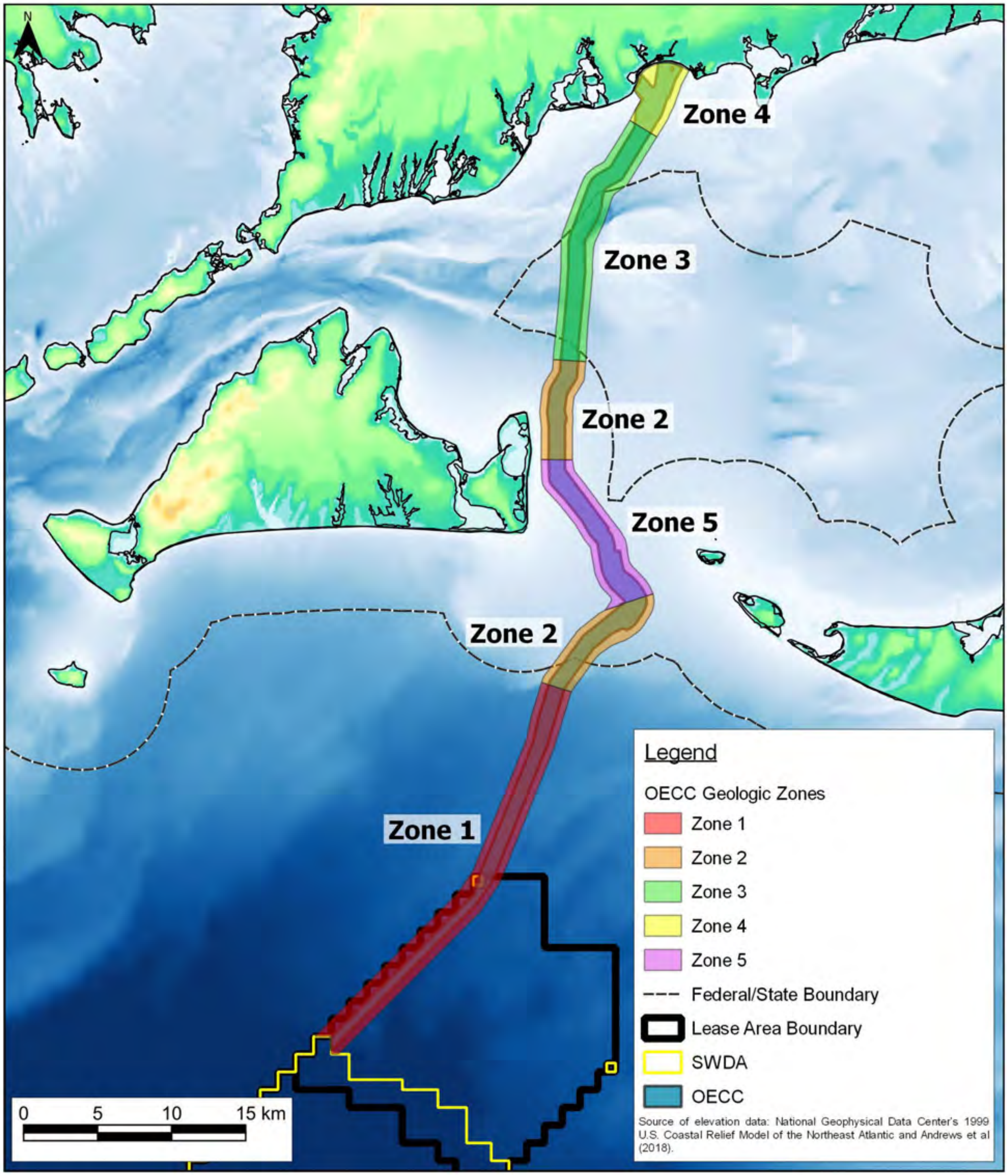


Figure 3.5-1: Geographic Analysis Area for Coastal Habitats and Fauna

Much of the OECC was described in Section 3.1 of the Vineyard Wind 1 Final EIS (BOEM 2021b) and reflects surveys conducted between 2016 and 2020. The portions of the OECC that were expanded for the proposed Project were surveyed in 2020. The OECC can be subdivided into five geological zones based on the physical characteristics and benthic substrates observed in proposed Project surveys (Figure 3.5-2). Coastal habitats are present in Zones 2, 3, 4, and 5 (COP Volume II-A, Section 2.1.3.1; Epsilon 2022a). Typically, water depth in the geographic analysis area for coastal habitats and fauna ranges from 0 to 49.2 feet but can be as deep as 131.2 feet. Benthic grab samples and underwater video transects collected during 2016 through 2020 biological surveys helped determine habitat type (COP Volume II-A, Section 5; Epsilon 2022a). Seafloor habitat types, based on the habitat categories defined in the COP (Volume II-A, Table 5.1-1; Epsilon 2022a), are primarily sandy but vary across geographical zones. Zone 2 is subject to high currents and exhibits a mainly sand and gravel bed with ripples and sand waves mostly 3.3 to 4.9 feet high. Some Zone 2 habitats include biogenic structures (e.g., burrows and sessile unshelled organisms), shell aggregates, or gravel-cobble beds. Zone 3 exhibits mostly flat sand and silt substrate with ripples and sand waves 3.3 to 6.6 feet high; biogenic structures are less common. Zone 4 is also primarily flat sand and silt. A minority of areas include small sand waves, shell aggregates, or gravel-cobble beds, in addition to rock piles associated with Spindle Rock, Collier Ledge, Gannet Ledge, Eldridge Shoal, and Gannet Rock. Zone 5 is subject to remarkably high currents and exhibits coarser bed material with some hard-bottom patches and sand waves. The sand waves are mostly 3.3 to 13.1 feet high but range up to 29.5 feet high. Zone 5 also includes shell aggregates, cobble beds with and without sponge cover, sulfur sponge (*Cliona californiana*) beds, and a few isolated boulders.

Seafloor habitats can also be classified more broadly as biogenic structures, hard bottom, complex seafloor, and other, which would include the majority of flat sand and mud habitat in the OECC. Hard bottom in the geographic analysis area for coastal habitats and fauna typically consists of a combination of coarse deposits such as gravel, cobble, and boulders in a sand matrix. These coarse deposits form a stable surface over which sand waves forced by tidal currents periodically migrate. Certain hard-bottom areas also include piles of exposed boulders, but no bedrock outcrops are present in the OECC. Complex seafloor in the OECC consists of bedforms such as rugged fields of sand waves; although these mobile habitats are less amenable to benthic macroinvertebrates, they may be attractive to finfish. Maps delineating these habitats based on the results of surveys reported in Epsilon (2022) are shown on Figures 3.5-3 through 3.5-7. In addition, CZM has defined a hard/complex bottom habitat (CZM 2014; Commonwealth of Massachusetts 2021a), which would generally include all of the biogenic structures, hard bottom, and complex seafloor in the OECC. Section 3.4 discusses benthic organisms associated with these types of habitats. Coastal habitat types defined by CZM (2014) and the Commonwealth of Massachusetts (2021a) do not necessarily align with NMFS classifications of hard, complex, or sensitive habitats as pertaining to EFH. Section 3.6, Finfish, Invertebrates, and Essential Fish Habitat, and the EFH assessment (BOEM 2022c) discuss habitats from the perspective of finfish, invertebrates, and EFH.

NMFS has requested mapping of the following habitat types: soft-bottom habitats (i.e., mud and/or sand); complex habitats (i.e., submerged aquatic vegetation, shells/shellfish, and/or hard-bottom substrate); heterogeneous complex habitats (i.e., mix of soft and complex stations within a delineated area); large-grained complex habitats (e.g., large boulders or rock outcrops); and benthic features (i.e., ripples, mega-ripples, and sand waves) (NMFS 2021b). Maps of those habitat types can be found in the COP (Volume II-A, Figures 5.2-5b and 5.2-5c; Epsilon 2022a). Compared to the habitat type definitions in the *Massachusetts Ocean Management Plan* (Commonwealth of Massachusetts 2021a) and the Vineyard Wind 1 Final EIS (BOEM 2021b), the definition of complex habitat in the NMFS (2021b) mapping recommendations has a smaller grain size threshold (at least 0.08 inch) and lower composition threshold (at least 5 percent gravel), making it a more conservative classification system. Therefore, more locations are now classified as complex, resulting in increased areas of complex or heterogeneous complex habitats than had been previously mapped in the Vineyard Wind 1 Final EIS (BOEM 2021b).



Source: COP Volume II-A, Figure 2.1-17; Epsilon 2022a
OECC = offshore export cable corridor; SWDA = Southern Wind Development Area

Figure 3.5-2: Geological Zones Along the Offshore Export Cable Corridor

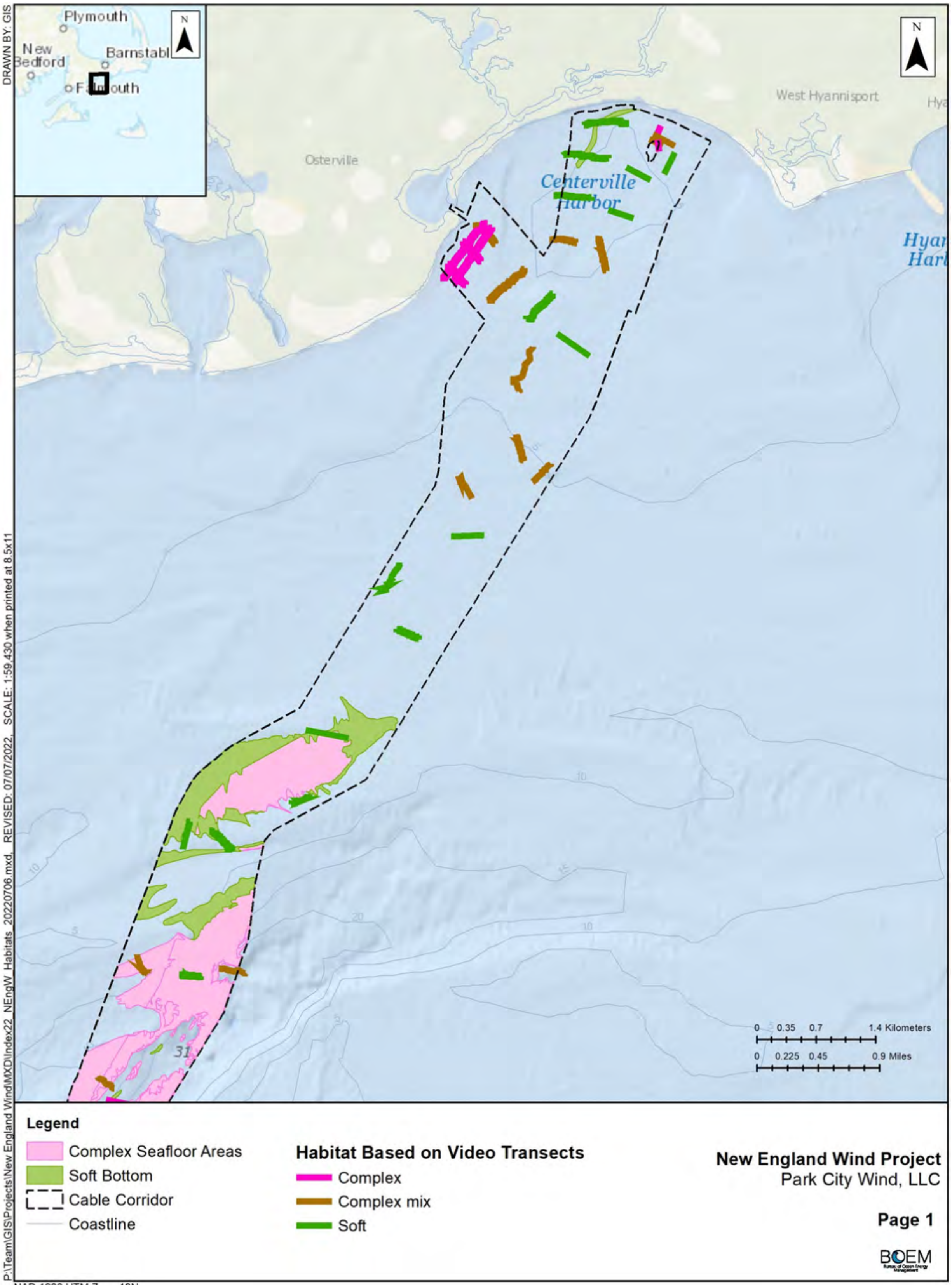


Figure 3.5-3: Seafloor Habitats Within the Offshore Export Cable Corridor (Page 1)

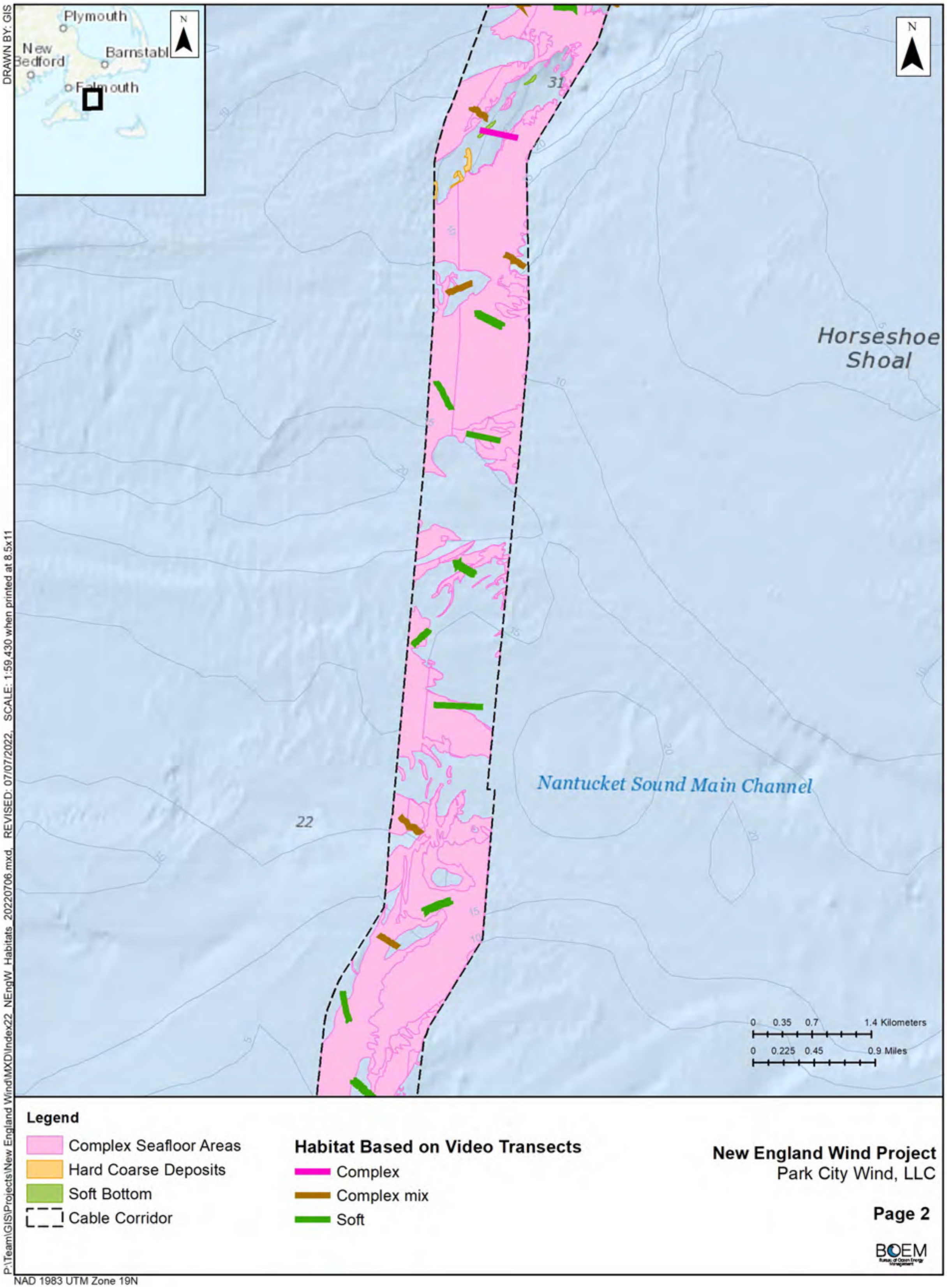


Figure 3.5-4: Seafloor Habitats Within the Offshore Export Cable Corridor (Page 2)

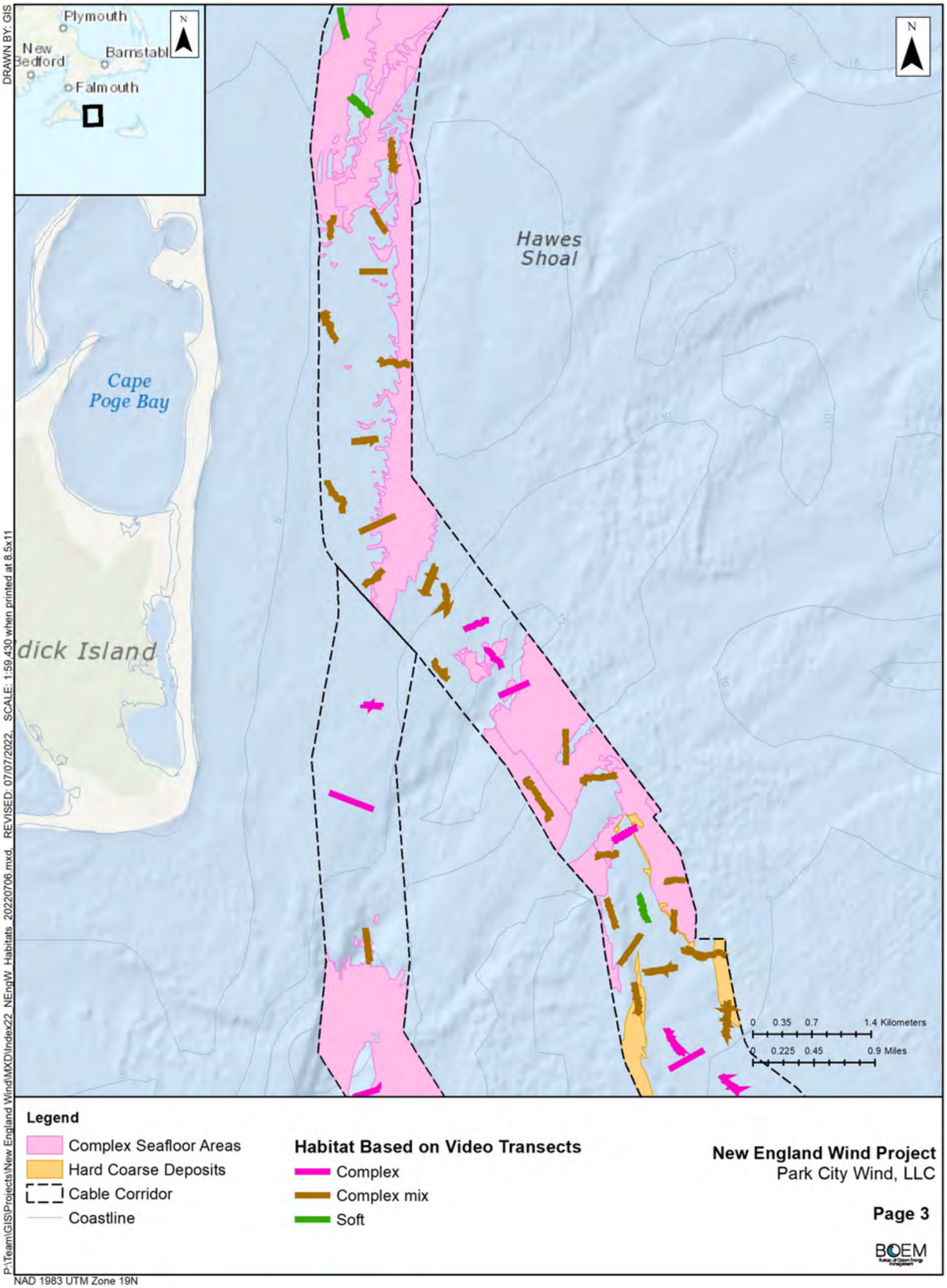


Figure 3.5-5: Seafloor Habitats Within the Offshore Export Cable Corridor (Page 3)

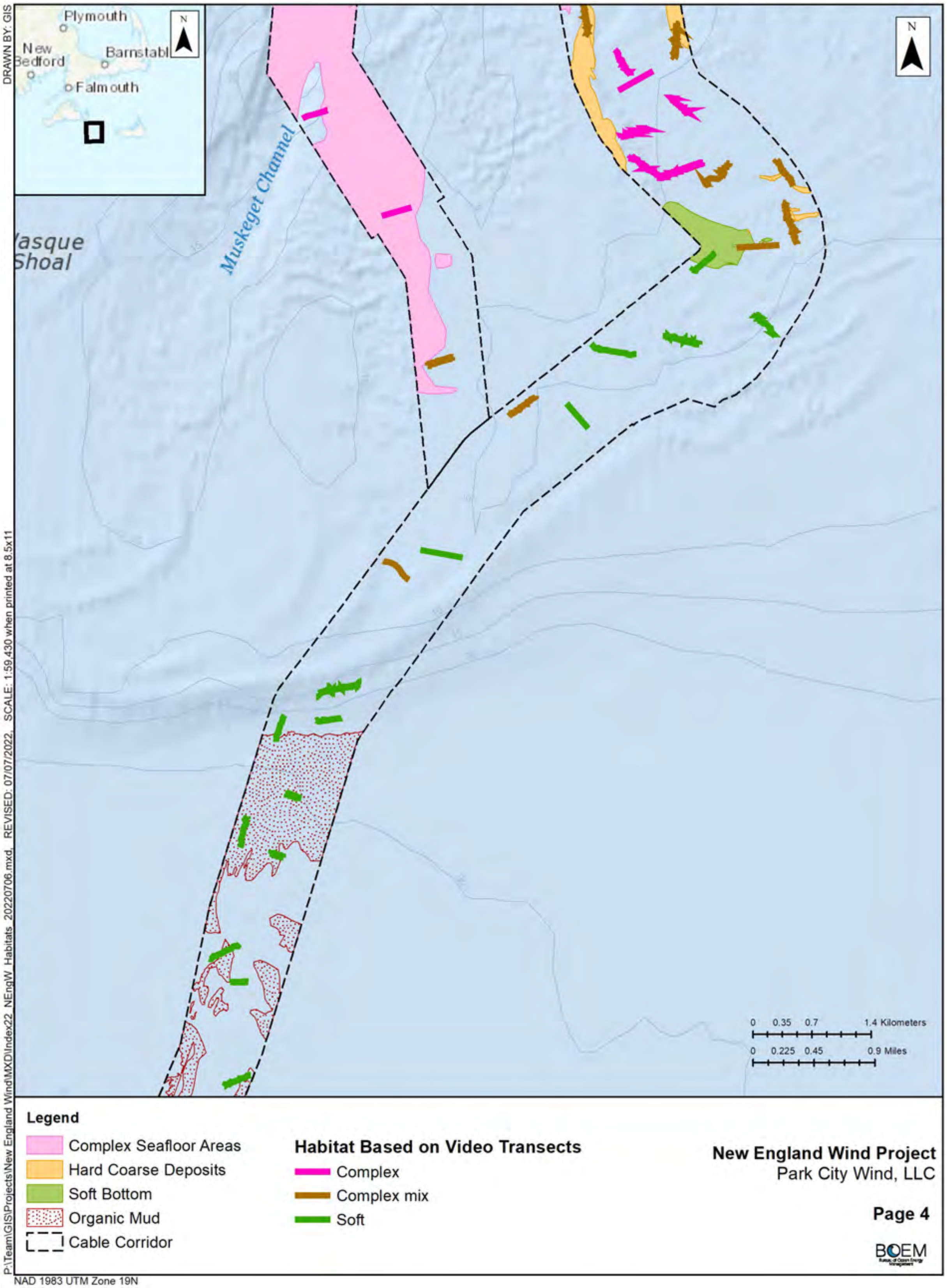


Figure 3.5-6: Seafloor Habitats Within the Offshore Export Cable Corridor (Page 4)

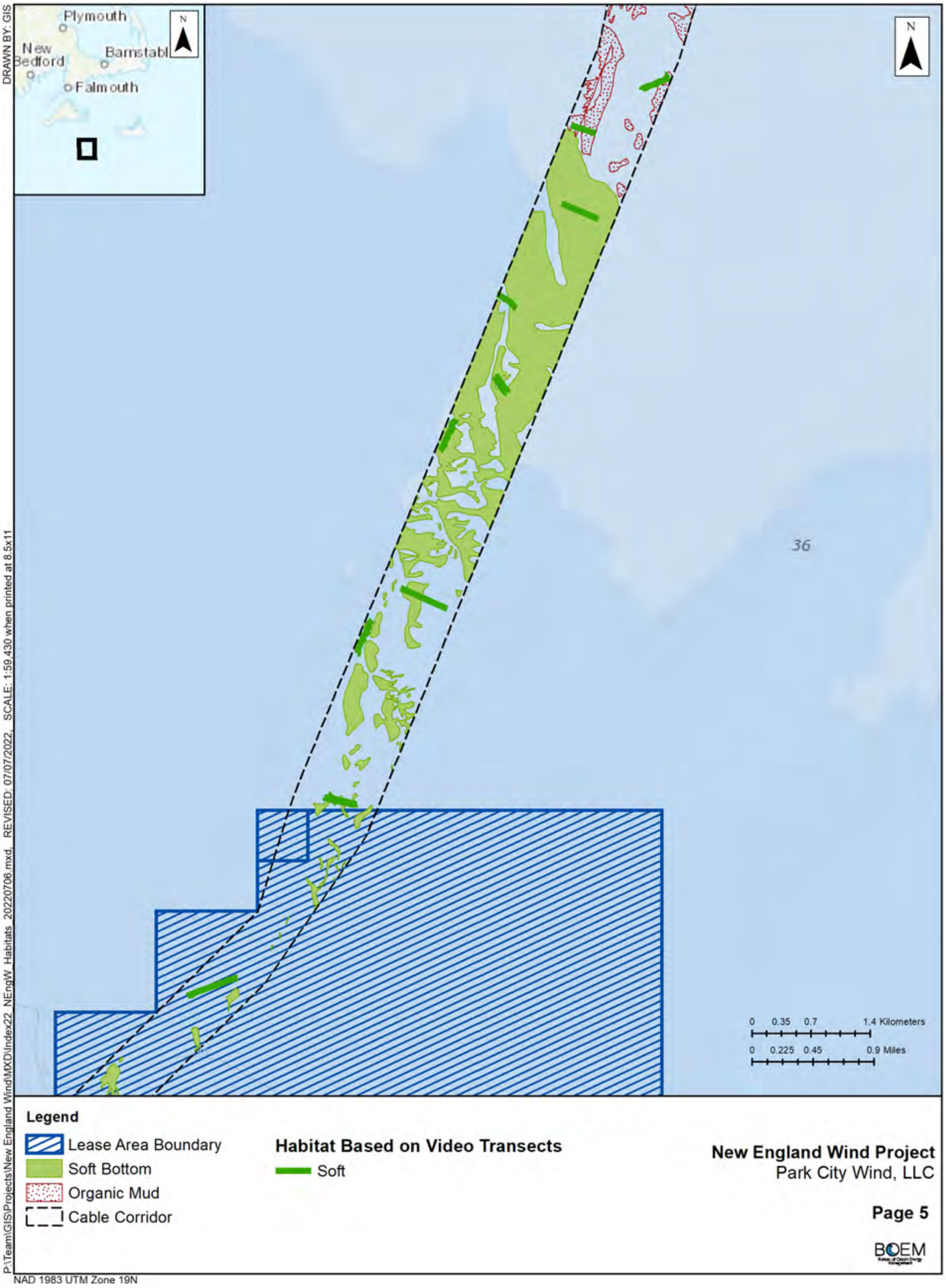


Figure 3.5-7: Seafloor Habitats Within the Offshore Export Cable Corridor (Page 5)

Benthic habitats and organisms recorded on video transect throughout the OECC were consistent from 2017 to 2020, with no major differences apparent. Within most of the OECC, the substrate is generally flat soft bottom, except for areas near Zone 5, which are coarser and more diverse (COP Volume II-A, Figure 5.1-3a; Epsilon 2022a). In addition, biogenic structures (e.g., burrows, depressions, cerianthid anemones, and hydroid patches) are present along the final 19 miles of the OECC leading to the landfall sites. Complex habitat, as defined by NMFS (2021b), was found mainly in the vicinity of Muskeget Channel and was composed mostly of sandy gravel, gravelly sand, shell hash, and gravel, with isolated boulders; complex habitat consisting of gravelly sand and gravelly muddy sand was also found near the Dowses Beach Landfall Site (COP Volume III, Section 6.4.1.2.2; Epsilon 2022a). Heterogeneous complex habitat, as defined by NMFS (2021b), was found scattered throughout the middle and northern portion of the OECC and within the southern portion of the Western Muskeget Variant (COP Volume II, Figures 5.2-5b and 5.2-5c; Epsilon 2022a). Large-grained complex habitat, as defined by NMFS (2021b), was mapped at Spindle Rock and Collier Ledge; the boulders in Muskeget Channel were not found in high enough density to be mapped as large-grained complex habitat (COP Volume III, Section 6.4.1.2.2; Epsilon 2022a). Benthic features consisting of ripples, mega-ripples, and sand waves occurred throughout the OECC, including within the Western Muskeget Variant (COP Volume III, Section 6.4.1.2.2; Epsilon 2022a).

The Commonwealth of Massachusetts considers special, sensitive, and unique (SSU) habitats such as living bottom, hard/complex bottom, eelgrass areas, and certain specific marine mammal habitats identified in the *Massachusetts Ocean Management Plan* to be high priorities for avoidance if possible (Commonwealth of Massachusetts 2021a). The proposed Project's cable corridor survey data were compared to existing data to assess the potential for SSU habitats in the immediate vicinity of the OECC (COP Volume II-A; Epsilon 2022a). The proposed OECC and historically mapped sensitive areas provided by Massachusetts are shown in the COP (Volume II-A, Figure 5.2-1a; Epsilon 2022a). The applicant has routed the proposed OECC to avoid sensitive habitat to the greatest extent practicable (Figures 3.5-2 through 3.5-6). The areas of habitats within 328 feet of the offshore export cable centerline are provided in Table 3.5-1.

Table 3.5-1: Coastal Habitat Types

Habitat Type	Extent, Proposed Project OECC (Acres)	Share of Proposed Project OECC (%)	Extent, Western Muskeget Variant OECC (Acres)	Share of Western Muskeget Variant OECC (%)
Complex seafloor	4,281.7	20.7	861.3	36.3
Soft bottom	1,518.6	7.4	0.0	0.0
Hard coarse deposits	167.9	0.8	0.0	0.0
Organic mud	644.3	3.1	0.0	0.0
Other habitats	14,031.0	68.0	1,508.6	63.7
Total	20,643.5	100%	2,369.9	100%

Source: COP Volume II; Epsilon 2022a

OECC = offshore export cable corridor

The applicant's survey data indicate hard-bottom habitat exists in portions of the OECC. This habitat type provides attachment sites for sessile benthic organisms, supports fish because the larger boulders and sponges rise above the seabed and are resistant to movement by currents, and supports other ecological functions, even where the hard-bottom habitat consists of low-relief pebbles. The Muskeget Channel area includes several pebble-cobble-sponge habitats and other hard/complex bottom habitats.

Eelgrass is a marine flowering plant that lives below the surface. Eelgrass beds provide the following:

- Nursery ground and refuge for commercially important organisms, such as bay scallops (*Argopecten irradians*), flounders, striped bass (*Morone saxatilis*), and tautog (*Tautoga onitis*), as well as other organisms such as seahorses;
- Habitat and food for waterfowl, shellfish, and finfish;
- Carbon capture and sequestration; and
- Sediment and shoreline stabilization (Heck et al. 1989).

A single eelgrass bed has been identified within the OECC, consisting of patches of eelgrass and macroalgae in the discontinuous sandy bottom in and around Spindle Rock, approximately 0.4 mile offshore of Covell's Beach (COP Volume III, Figure 6.4-1; Epsilon 2022a). Section 3.6 discusses EFH and eelgrass beds. Spindle Rock also exhibits hard/complex bottom habitat.

Trends

Coastal habitats and fauna 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 (Costello and Kenworthy 2011). Sandy beaches in these areas are subject to erosion and vulnerable to the effects of projected climate change and relative sea level rise (Roberts et al. 2015). The shoreline is partially developed with residences, and this development is likely to continue.

The lack of any major river in the area to discharge water and sediment contributes to the relative consistency of local geology and coastal habitats over time. Flat sand beds are regionally common, locally abundant, and not expected to change significantly over time. Sand waves are locally abundant and mobile over the course of days to years. There is often significant patchiness and sample-to-sample variability in habitats and benthos across space and time (MMS 2009).

Strong tidal currents near Muskeget Channel lead to greater temporal variability, as each tidal cycle rearranges the finer substrates in the area. BOEM expects this process to be in a state of dynamic equilibrium over the coming decades. In areas with moderate current outside Muskeget Channel, sand waves naturally migrate across the seafloor.

Historical maps of hard/complex bottom (CZM 2014; Commonwealth of Massachusetts 2021a) indicated the presence of such habitats in all of Muskeget Channel proper. In addition, surveys conducted in 2017 and 2018 (COP Volume II-A; Epsilon 2022a) found hard/complex bottom covering much of the Muskeget Channel area. The areas of each coastal habitat type present along the OECC, as defined above, are shown in Table 3.5-1.

Eelgrass beds in this region cover much less area than historically estimated (Cape Cod Commission 2011). A long-term study of eelgrass beds in Massachusetts reported a decline in coverage at 30 of the 46 sites, with a total loss of 20.6 percent between 1994 and 2007 (Costello and Kenworthy 2011). Eelgrass beds are threatened by anthropogenic activities, and declines in this habitat have been correlated with "physical disturbances (i.e., dredging, construction, shell fishing, propeller damage from boating), turbidity (i.e., topsoil runoff, activities that re-suspend sediments), pollution, and most notably, eutrophication as a result of nutrient loading" (CCS 2017).

Shorelines in the geographic analysis area for coastal habitats and fauna are primarily sand beaches, rocky shores, salt marsh, and armored shorelines. Landward of the intertidal zone, coastal habitats in the geographic analysis area for coastal habitats are mostly a mixture of sandy beaches and developed spaces.

Coastal habitats on Martha’s Vineyard and Chappaquiddick Island also include sand dune habitats, salt ponds, salt marshes, and scattered maritime forest. Sandy beaches in these areas are subject to erosion and vulnerable to the effects of projected climate change and relative sea level rise (Roberts et al. 2015). Mainland coastal habitats in the geographic analysis area for coastal habitats mostly consist of sandy beach and dune vegetation; much of this is developed for public beach and private residences (Thieler et al. 2013).

Coastal habitats are subject to pressure from ongoing activities, especially those that involve anchoring, seabed profile alterations, sediment deposition and burial, gear used for bottom trawling and dredge fishing, and climate change. The greatest concerns regarding potential impacts on coastal habitats are potential impacts on SSU habitats, especially living bottom, hard/complex bottom, eelgrass beds, and marine mammal habitats. Ongoing development, commercial fishery activities, and tourism in the area can affect the sensitive habitats (e.g., hard/complex bottom and eelgrass beds) in the geographic analysis area for coastal habitats.

Commercial fishing using bottom trawls, dredge fishing methods, 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 cable emplacement and maintenance 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 Town of Barnstable, 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. Increased nutrient loading can affect coastal wetlands and other nearshore coastal habitats. Nutrient overloading in estuaries and coastal waters goes back several decades (Cape Cod Commission 2011). The Town of Barnstable’s 2020 Comprehensive Wastewater Management Plan (Town of Barnstable 2020) would address nonpoint source nutrient pollution through sewer system upgrades and expansions, wastewater treatment upgrades, and other projects to be completed over a 30-year period. Discharges from vessels are not permitted within 3 nautical miles (3.5 miles) of shore.

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 used 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. Activity associated with anchoring, dredging, and bottom-focused fishing gear is expected to continue at current levels. Climate change, including ocean acidification, ocean warming, and sea level rise, also affects coastal habitats. All of these ongoing impacts would continue regardless of the offshore wind industry.

3.5.2 Environmental Consequences

Definitions of impact levels for coastal habitats and fauna are described in Table 3.5-2.

Table 3.5-2: Impact Level Definitions for Coastal Habitats and Fauna

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

3.5.2.1 Impacts of Alternative A – No Action Alternative on Coastal Habitats and Fauna

When analyzing the impacts of Alternative A on coastal habitats and fauna, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the existing conditions for coastal habitats and fauna (Table G.1-2 in Appendix G). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for coastal habitats and fauna described in Section 3.5.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on coastal habitats and fauna include commercial bottom trawling and dredge fishing, anchoring, seabed profile alterations, sediment deposition and burial, climate change, and the construction of the Vineyard Wind 1 OECC. The impacts on coastal habitats and fauna from these ongoing and future non-wind activities would continue and result in similar impacts regardless of offshore wind energy development. The rate might be uncertain, but their impacts on coastal habitats and fauna would be detectable with monitoring of habitat structure and coverage.

Planned activities other than offshore wind that could affect coastal habitats and fauna include increasing vessel traffic; new submarine cables and pipelines; increasing onshore construction; marine surveys; marine minerals extraction; channel deepening activities; beach nourishment projects; the installation of new towers, buoys, and piers; and construction of the Mayflower Wind Project OECC.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than

Alternative B). Future offshore wind development activities would affect coastal habitats and fauna through the following primary IPFs.

Accidental releases: Accidental releases may increase as a result of future offshore wind activities. Section G.2.2, Water Quality, discusses the nature of releases anticipated. The risk of any type of accidental release would increase primarily during construction but also could occur during operations and decommissioning of offshore wind facilities. Accidental releases of fuel/fluids/hazardous materials 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 of projects associated with Alternative A. 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/temporal extent of accidental releases of trash and debris would have any impact on coastal habitats. The overall impacts of accidental releases on coastal habitats and fauna are likely to be localized, 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 and gear utilization: Increased anchoring may occur in coastal habitats during survey activities and during the installation of offshore export cables. The resulting impacts on coastal habitats and fauna would include temporarily increased turbidity levels and the potential for contact to cause physical damage to coastal habitats. For example, 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, and physical damage could be long term to permanent if it occurs in eelgrass beds or hard-bottom habitat.

Cable emplacement and maintenance: Installation of offshore submarine cables could cause short-term disturbance of seafloor 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-wide path along the entire cable route. Assuming future projects use installation procedures similar to those proposed in the COP (Volume I, Section 3.3.1; Epsilon 2022a), coastal habitats and fauna would recover following disturbance except in hard-bottom habitat, which may be permanently altered. Cable emplacement may affect coastal habitats and fauna multiple times, as different projects may install cable in consecutive or non-consecutive 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.

If dredging is used during cable installation in coastal habitats, localized, short-term impacts on coastal habitats and fauna would result. Dredging typically occurs only in sandy or silty habitats, which are abundant in the region and are quick to recover from disturbance (Wilber and Clarke 2007). Furthermore, sand waves in coastal habitats 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.

Dredged material disposal 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 likely have little impact on coastal habitats and fauna, as defined in this section. Cable emplacement and maintenance activities during construction or operations 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 habitats, while in hard-bottom habitats, the impacts would likely be minimal and short term to long term, depending on the thickness of deposited sediment, local currents, and the nature of the habitat affected (Wilber et al. 2005). Sediment deposition from simultaneous or sequential activities would likely not be interactive due to the distance between the offshore wind projects.

Climate change: Climate change, influenced in part by greenhouse gas (GHG) emissions, is expected to continue to contribute to a widespread loss of shoreline habitat from rising seas and erosion. Ocean acidification caused by atmospheric CO_2 may contribute to reduced growth or the decline of reefs and other habitats formed by shells. Section G.2.1, Air Quality, describes the expected contribution of offshore wind activities to climate change.

EMF: Operating transmission cables in coastal habitats would generate EMF. Section 3.4, Benthic Resources, discusses the nature of potential impacts. Submarine power cables 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 spacing between cables, except where cables cross. EMF strength diminishes rapidly with distance, and potentially meaningful EMF would likely extend less than 50 feet from each cable. Where one cable crosses another, such as the Mayflower Wind Project offshore export cables crossing the Vineyard Wind 1 offshore export cables, the intensity of the EMF would likely remain below the levels to which marine organisms are known to respond (Section 3.6 and Section 3.7, Marine Mammals). Any impacts of EMF on coastal habitats and fauna would likely be undetectable.

Land disturbance: Cable landfall sites 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 and fauna to recover between events. Cable landfall sites and/or onshore transmission routes 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 impact could also involve land use changes that permanently convert onshore coastal habitats to developed space.

Lighting: Light from vessels transiting between berths in coastal locations to/from nearshore and offshore work locations or from vessels installing cables, if any, 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 facilities). 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.

Noise: Noise from offshore wind construction activities, including pile driving, is not expected to be noticeable, due to the distance of all planned projects from coastal habitats, but noise from trenching of export cables and from G&G surveys could reach coastal habitats. The impacts of trenching noise or 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 occur intermittently between 2022 and 2030 (Appendix E). 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 during the construction period for Alternative A, between 2022 and 2030 (Appendix E). The intensity and extent of the resulting impacts on coastal habitats and fauna 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 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. The new habitat may or may not function similarly to hard-bottom habitat typical in the region (BOEM 2019b; Kerckhof et al. 2019). Soft-bottom habitat 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). Thus, conversion of some abundant soft-bottom habitat to a rarer hard habitat may constitute a beneficial impact (NOAA 2007). Structures can also create an artificial reef effect, attracting a different community of organisms (English et al. 2017; Langhamer 2012; Paxton et al. 2020; Rousseau 2008). Cable protection is anticipated to be added incrementally from 2022 through 2030 (Appendix E). 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.

Conclusions

Impacts of Alternative A. Under Alternative A, coastal habitats and fauna would continue to be affected by existing environmental trends and ongoing activities. Considering all the IPFs together, the overall impacts of Alternative A would include both **moderate** and **minor** beneficial impacts. The majority of offshore structures in the geographic analysis area for coastal habitats and fauna would be attributable to the future offshore wind industry.

Cumulative Impacts of Alternative A. Planned activities for coastal and marine activity other than offshore wind include development of diversified, small-scale, onshore renewable energy sources and peaker plants; continued increases in the size of commercial vessels; and potential port expansion and channel deepening activities. BOEM anticipates that the cumulative impacts on coastal habitats and fauna communities would be **minor**, both adverse and beneficial, driven primarily by the continued operation of existing marine industries; increased pressure for environmental protection of coastal resources; and the need for port maintenance and upgrades.

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 and fauna in the geographic analysis area. The future offshore wind industry would also be responsible for the majority of impacts related to new cable emplacement and maintenance. Except for those two IPFs, the impacts of the future offshore wind activities would be difficult to distinguish from the impacts of ongoing activities and future non-offshore wind activities.

3.5.2.2 Relevant Design Parameters and Potential Variances in Impacts

The following proposed Project design parameters would influence the magnitude of the impacts on coastal habitats and fauna:

- OECC route near Muskeget Channel: The proposed OECC route and Western Muskeget Variant (Phase 2 only) could have differing impacts on coastal habitats.
- Number of offshore export cables installed: Five total offshore export cables would be more impactful than four offshore export cables.

- Number and location of landfall sites selected: The Dowses Beach and Wianno Avenue landfall sites for Phase 2 could result in different impacts, and the applicant may elect to use both sites for Phase 2.
- Method for crossing the Centerville River and, possibly, East Bay: The onshore export cable for Phase 1 would cross the Centerville River, and the onshore export cable for Phase 2 may cross under East Bay. The applicant would use trenchless methods for the East Bay crossing, although that crossing would have a greater potential for impacts on submerged coastal habitats than other Phase 2 routes that avoid this crossing. Crossing the Centerville River using trenchless methods would likely be less impactful than building a new utility bridge.
- Dredging and cable installation methods: Among the proposed methods (see the cable emplacement and maintenance IPF below), use of a TSHD would likely cause greater impacts, both in the dredging corridor and spoils dumping areas, than jetting or mass flow excavation. Likewise, the applicant may be able to accomplish cable burial with fewer impacts if jetting were the primary burial method used, especially if it avoids the need for dredging.

3.5.2.3 Impacts of Alternative B – Proposed Action on Coastal Habitats and Fauna

This section identifies potential impacts of Alternative B on coastal habitats and fauna. Except where otherwise stated, the impacts of Phase 1 decommissioning would be similar to those for Phase 1 construction for all of the IPFs described below. Section 3.4 includes a more complete description of seafloor impacts from cable emplacement and maintenance.

Impacts of Phase 1

Phase 1 would affect coastal habitats and fauna through the following primary IPFs during construction, operations, and decommissioning.

Accidental releases: Section 2.3 describes the non-routine activities associated with Phase 1. These activities, if they were to occur, would generally require intense, temporary activity to address emergency conditions, accidental spills of fuel, lubricating oils, HDD drilling mud, or other materials used inside equipment during construction, operations, and decommissioning. The applicant's implementation of OSRPs (COP Appendix I-F; Epsilon 2022a) would limit any impacts of accidental releases from Phase 1 to **minor**.

Anchoring and gear utilization: Anchoring may occur anywhere along the OECC (COP Volume I; Epsilon 2022a). Anchoring would not be allowed within known eelgrass beds, and vessels deploying anchors would avoid SSU habitats to the greatest extent practicable. The applicant estimated that anchoring, grounding, spud legs, and jack-up vessels would disturb up to 35 acres in the OECC (excluding areas disturbed by anchor sweep), some of which would occur outside the geographic analysis area for coastal habitats and fauna—that is, offshore of the 3-nautical-mile (3.5-mile) seaward limit defining coastal habitats (COP Volume I, Section 3.3.1.13; Epsilon 2022a). Anchoring would leave a temporary mark on the seabed. If the proposed Project anchored upon any hard/complex bottom or cobble-sponge beds, damage or destruction of that part of the habitat could result in **moderate** impacts. For those areas outside of SSU habitats, the impacts would be **minor**, as the disturbances would recover naturally. The **minor** to **moderate** incremental impact of anchoring under Phase 1 would result in temporary to permanent impacts on coastal habitats and fauna, depending on the nature of the habitat affected.

BOEM has considered the development and implementation of an anchoring plan (Appendix H, Mitigation and Monitoring) as an additional mitigation and monitoring measure for this resource, potentially in combination with additional habitat characterization. Such a plan could reduce the area of sensitive habitats affected by anchoring, possibly reducing the severity of anchoring impacts.

Cable emplacement and maintenance: After a pre-lay grapnel run and, possibly, boulder relocation, the applicant would bury the proposed offshore export cables within the OECC to a target depth of up to 5 to 8 feet below the seafloor (COP Volume I, Section 3.3.1.3; Epsilon 2022a). Phase 1 would lay two offshore export cables within the OECC, as well as one or more fiber optic cables for communication purposes. The OECC for the proposed Project is largely the same OECC as that evaluated in the Vineyard Wind 1 Final EIS (BOEM 2021b), but it has been widened by approximately 984 feet to the west along the entire corridor and by approximately 984 feet to the east in portions of Muskeget Channel. The maximum length of each cable within the OECC is approximately 45 nautical miles (51.8 miles).

The applicant has proposed several cable burial methods that would be used in different portions of the OECC or in combination. Jetting, or mass flow excavation, uses water jets to push sediment aside, but this method is not able to remove as much sediment as dredging, which may be required on larger sand waves. For cable burial, jet plowing, which is a similar method to jetting, uses water pumped into the seabed to fluidize the bed and allow the cable to sink to the appropriate depth. Mechanical plowing would bury the cable behind a cutting edge that is pushed through the seabed. Mechanical trenching, which would be mostly used for coarser sediments, uses a rotating cutting tool to create a trench in which the cable can be installed and buried. Other possible installation techniques include precision installation by divers or remotely operated vehicles (ROV) and a blunt plow used to push aside boulders (COP Volume I, Section 3.3.1.3; Epsilon 2022a).

Dredging may be necessary in areas of sand waves to bury the cable in stable seabed (see the cable emplacement and maintenance IPF and COP Volume II, Figure 3.2 3 [Epsilon 2022a] for an example of places prone to large sand waves). Installation method selection would prioritize the achievement of adequate burial depth, while using the “least environmentally impactful [method] that is practicable for each segment of cable installation” (COP Volume I, Section 3.3.1.3.6; Epsilon 2022a). If sufficient burial is not achieved on the first installation pass, the applicant would make subsequent attempts, possibly using other installation techniques to achieve sufficient burial. In certain areas, alternative installation methods may be needed. The installation methodologies are described in detail in the COP (Volume I, Section 3.3.1.3; Epsilon 2022a). Table 3.5-3 summarizes the distribution of dredging within 3 nautical miles (3.5 miles) of the high tide line (the limit of USACE jurisdiction under CWA Section 404)—often referred to as “state waters”—and between 3 nautical miles and the seaward limit of the OCS (the limit of USACE jurisdiction under RHA Section 10)—commonly referred to as “federal waters.” No drilling or blasting would be required. Although difficult to predict quantitatively, burial impacts would likely be minimized if jetting and/or plowing methods were used (BERR 2008), especially if these methods avoid the need for dredging, resulting in **minor** impacts.

Table 3.5-3: Phase 1 Impacts within U.S. Army Corps of Engineers Jurisdiction (Cubic Yards)

Habitat Type	State Waters[a]	Federal Waters[a]	Total
Dredge volume	109,800	66,600	176,300
Fluidized trench sediment volume[b]	148,322	0	148,322

Source: Epsilon 2022b

[a] State waters include open waters areas from the high tide line to 3 nautical miles (3.5 miles) from shore. Federal waters include open waters from the 3-nautical-mile limit to the seaward limit of the OCS.
[b] The applicant assumed that an area up 1 meter (3.3 feet) wide and 1.5 meters (4.9 feet) deep may be fluidized during installation with a jet plow.

The process of cable laying and burial would affect seafloor coastal habitats along the OECC (Figure 2.1-2). Although some of the OECC area is outside the 3-nautical-mile line that defines coastal habitats and fauna, cable installation along the entire OECC may temporarily affect up to 263 acres in the maximum-case scenario (COP Volume I, Section 3.3.1.13; Epsilon 2022a). This process would affect coastal habitats and fauna through cable burial, sediment suspended by the burial process, and the installation of cable protection. Where the applicant would install the cable over coarse substrates (shell aggregates, pebble-cobble, etc.), the coarser material would likely settle first and become covered by the finer sandy and silty materials that settle more slowly. Thus, the proposed Project would likely convert some surface area to a simpler surface of lower habitat value.

The preliminary routing of the cables has avoided sensitive habitats including eelgrass, hard bottom, and complex bottom (i.e., sand waves) where feasible, but avoidance of all sensitive habitats is not always possible. It is expected that the identified eelgrass resources near Spindle Rock in proximity to the landfall sites would be avoided (COP Volume III, Figure 6.4-1; Epsilon 2022a). It is also expected that isolated areas of hard bottom may be avoided, such as at Spindle Rock; however, in areas such as Muskeget Channel where hard bottom extends across the entire corridor, it would not be possible to avoid hard bottom. Regarding sensitive habitats in the OECC, the applicant has performed multiple years of investigations focused on identifying both suitable cable corridors from an engineering and cable design perspective and appropriate alignments aimed at avoiding SSUs and EFH while reducing environmental impacts. By the end of 2019, more than 2,655 miles of geophysical trackline data, 123 vibracores, 83 cone penetrometer tests (CPT), 82 benthic grab samples with still photographs, and 50 underwater video transects were gathered to support the characterization of the OECC. Additional survey data were collected for the expanded portions of the OECC in 2020; these data, in conjunction with the data already collected, will be used by the cable installation contractor (once selected) to further assess conditions present in the OECC, determine cable alignments within the OECC, and select cable installation tools that are appropriate for the site conditions. COP Volume II, Section 5.2.4 (Epsilon 2022a) demonstrates that due diligence has been performed in selecting an OECC. The current OECC, which is largely the same OECC already approved by BOEM for Vineyard Wind 1 (BOEM 2021b), allows for less impact on sensitive habitats than other potential OECC routes that Park City Wind and Vineyard Wind evaluated.

Cable installation would disturb biogenic structures along the OECC leading to the landfall site (COP Volume II-A, Section 5.1.1.3; Epsilon 2022a). The approach to the landfall site would pass near Spindle Rock's hard-bottom habitat and eelgrass bed but completely avoid both habitats (COP Volume III, Section 6.4.2.1.1; Epsilon 2022a). At the landfall site, onshore impacts on coastal habitats and fauna would be non-existent to **negligible** because the use of HDD to transition from offshore to onshore would avoid coastal habitats and fauna in the shore area. The specific cable routes chosen in the OECC in the vicinity of Muskeget Channel may affect the level of impact. While both of the proposed route options through the Muskeget Channel area contain hard bottom and complex bottom, the applicant has selected the eastern option for the Phase 1 cables. The areas of each coastal habitat type present along the OECC are shown for each Muskeget Channel option in Table 3.5-1. The impacts on the hard-bottom habitat within either Muskeget option could result in **moderate** impacts, while flatter, sandier areas would likely experience **minor** impacts that may recover naturally.

Impacts on coastal habitats and fauna at the landfall site would be avoided because the sea-to-shore transition vault would be located in a paved area and HDD technology would be used to bury the cable beneath the beach. Estuarine coastal habitats associated with the Centerville River in the vicinity of the onshore export cable, especially salt marsh habitat, could be affected if the applicant selects a utility bridge as the crossing method. Although the applicant prefers microtunneling under the Centerville River, which would avoid impacts on coastal habitats and fauna, if a utility bridge were chosen, up to 48 square feet of salt marsh could be temporarily disturbed, of which up to 42 square feet could be permanently altered by bridge pilings (COP Volume III, Section 6.1.2.1; Epsilon 2022a). The new abutment/foundation would require new piles to be driven within the existing riprap, and some riprap would also need to be removed and replaced. Based on the current conceptual design, the new abutment/foundation would result in a minimal amount of temporary and permanent impacts on salt marsh (COP Volume III, Figure 3.3-5d and Section 6.1.2.1.1; Epsilon 2022a).

At locations with large sand waves, dredging may be necessary to allow the offshore export cable to be buried in stable seabed. The applicant anticipates that, where necessary, dredging would occur within a corridor that is 50 feet wide at the top of the sand wave, with side slopes of approximately 1:3, and a depth averaging approximately 1.6 feet and a maximum depth of up to 17 feet. If needed, a TSHD would remove sediment using suction, store the sediment in a hopper, and dump the sediment in piles on the seafloor at a different place within the OECC, several hundred yards away from the dredged area. In the maximum-case scenario, the use of dredging for Phase 1 could affect up to approximately 67 acres of bottom habitat, although some of this would occur outside of the geographic analysis area for coastal habitats and fauna. Considering the area affected in relation to the expanse of surrounding sand wave habitat, impacts would likely be **minor**.

The applicant conducted a sediment transport analysis to model the potential distribution of suspended sediment during dredging and cable installation (COP Appendix III-A, Epsilon 2022a). The model evaluated sediment suspension from dredging and jetting used for cable burial. The sediment model indicated that sediment deposition greater than 0.04 inch would be mostly limited to within approximately 328 feet of the cable centerline but can extend up to 1.4 miles from dredging activities (COP Appendix III-A; Epsilon 2022a). Deposition of 0.04 to 0.2 inch would probably have a **minor** impact on seafloor habitat, as normal water movements would likely redistribute this thin layer of sediment, while deposition of lesser amounts would probably have a **negligible** impact on coastal habitats and fauna (Wilber et al. 2005). According to the model, deposition of 0.04 to 0.2 inch of sediment could potentially occur on up to 2,248 acres (although part of this area would lie outside of the geographic analysis area for coastal habitats and fauna), while deposition of 0.4 inch or more would be limited to approximately 91 acres along the OECC. The impact of such sediment deposition would likely be undetectable in habitats other than hard-bottom habitats. In hard-bottom habitats, the impacts would likely be **minor** and short term to permanent, depending on the thickness of deposited sediment, local currents, and the nature of the habitat affected (Wilber et al. 2005).

Sedimentation of eelgrass or shellfish beds could impact habitat quality, and any eelgrass beds within approximately 328 feet of the cable centerline would be vulnerable. The closest such habitat is the Spindle Rock eelgrass bed and hard-bottom habitat complex near the proposed OECC approaching the Covell’s Beach Landfall Site. Using the preliminary cable alignment, the closest distance between the OECC alignment for the Covell’s Beach Landfall Site and eelgrass beds is approximately 1,000 feet. The closest distance between the western cable and the hard-bottom habitat near Spindle Rock is approximately 300 feet. According to the results of the sedimentation model (COP Appendix III-A; Epsilon 2022a), cable installation should not affect the eelgrass, given its distance from the cable. Given the distance between the hard-bottom habitat near Spindle Rock and the preliminary cable routes, most sediment deposition from cable installation would not affect this habitat, although there is the potential for the closest portion of the Spindle Rock complex to fall within the outer limits of the potential area of deposition.

Sediment deposition and burial would also occur where dredged materials, if any, are deposited. In addition to the area buried by the main part of each dredge spoils pile, sedimentation is predicted to extend a considerable distance from the pile; deposition greater than 0.8 inch may extend up to 0.5 mile from each disposal site and cover up to 34.6 acres (COP Appendix III-A; Epsilon 2022a). Alternatively, jet excavation and/or jet plowing would minimize the movement of sediment outside of the immediate burial corridor and, thus, affect less area of coastal habitats along the OECC. Considering that the impacts of sediment deposition and burial would remain measurable until the impacting agents were removed, the impacts of sediment deposition under Phase 1 would likely be **minor**.

BOEM could require the applicant, as a condition of COP approval, to restrict its dredge disposal sites, as described in Appendix H. This could minimize impacts on sensitive habitats and allow for the identification of potential remedial efforts if misplacement of materials were to occur. Although this could reduce the impacts of burial during dredged material disposal, the sediment deposition impacts described above would still occur; therefore, the level of impacts would remain the same.

BOEM could require as a condition of COP approval, that the applicant restrict its dredging and cable installation methods and timing, as described in Appendix H, potentially in combination with additional habitat characterization. This could reduce the degree of new cable emplacement impacts compared to the maximum-case scenario, although the impacts described above would still occur; therefore, the level of these impacts would remain the same.

Regular operations activities would not cause further habitat alteration or impact coastal habitats and fauna. However, when cable inspection or repairs require excavation onshore or offshore, **minor**, short-term, and localized impacts could occur. Maintenance of the offshore export cables could affect submerged coastal habitats if vessel anchoring, seafloor dredging, or the removal of scour protection were necessary to affect cable repairs. The impacts would be similar in nature to initial cable installation but would be smaller in physical extent.

During decommissioning, the applicant may remove the offshore export cable and cable protection unless otherwise authorized by BOEM (COP Volume I, Section 3.3.3.4; Epsilon 2022a). Impacts on coastal habitats and fauna from decommissioning would be similar to construction if decommissioning requires the removal of cables and cable protection. Any hard-bottom habitat created by the proposed Project would be removed, returning the habitat to its original type. If the cables were instead retired in place, the impacts of decommissioning on coastal habitats and fauna would be **negligible**.

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. The impacts on coastal habitats and fauna through this IPF would be the same as those under Alternative A. The intensity of impacts on coastal habitats and fauna resulting from climate change are uncertain but are anticipated to qualify as **minor** to **moderate**.

EMF: Considering the proposed cable burial depth and shielding, the extent of EMF would likely be less than 50 feet from any cable, and the intensity of impacts on coastal habitats and fauna would likely be **negligible**.

Land Disturbance. The applicant has proposed to cross the tidal Centerville River by using microtunneling to construct a concrete pipe under the river to house the onshore export cables. Other potential trenchless crossing methods could include HDD, direct pipe, or a parallel utility bridge. The utility bridge method would only be used if all other trenchless methods are infeasible (COP Volume I, Section 3.3.1.10; Epsilon 2022a). Phase 1 would not directly affect any area of tidal waters or wetlands, except for removal of up to 48 square feet of estuarine marine deepwater wetlands in the Centerville River (including 42 square feet permanently converted to bridge infrastructure) if the applicant must use a utility bridge crossing. Removal of the utility bridge during decommissioning would enable the affected area to become a wetland again, although the type and function may differ from existing conditions. As a result, land disturbance from Phase 1 would have long-term, localized, and **negligible** impacts on coastal habitats and fauna.

Lighting: Phase 1 would not result in new lighted structures within the geographic analysis area for coastal habitats and fauna. Phase 1 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 Phase 1 would likely lead to **negligible** impacts, if any, on coastal habitats and fauna. Light from structures and vessels during Phase 1 operations would lead to **negligible** impacts, if any, on coastal habitats and fauna because of the distance of the proposed Project from the coastline.

Noise: Noise from trenching and burial of export cables may occur during construction, although most of the export cables would likely be installed using a trenchless jet-plowing method. Trenching and burial noise would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching and burial noise are typically less prominent than the impacts of the physical disturbance and sediment suspension. Noise from trenching and burial would likely have **negligible** impacts on coastal habitats and fauna. Phase 1 would also emit noise from G&G surveys used to inspect the cable routes before and after installation. G&G noise resulting from cable route surveys would cause temporary and **negligible** impacts in the immediate vicinity of the cable routes.

Onshore noise and human activity from cable installation at the landfall site and the crossing of the Centerville River would be temporary and localized to the cable route. Displaced wildlife could use adjacent habitat and would repopulate these areas once construction ceases. Because construction would predominantly occur in already developed areas where wildlife is habituated to human activity and noise regardless of the cable route chosen, this would be a temporary and **negligible** impact.

Phase 1 would have a **negligible** incremental impact on coastal habitats and fauna through noise related to G&G activities and trenching, while no noise impacts on coastal habitats and fauna from construction or pile driving can be attributed to Phase 1, although ongoing activities are expected to result in local, temporary impacts.

Presence of structures: If sufficient cable burial is not achieved, cable protection measures such as rock placement, gabion rock bags, concrete mattresses, half shell pipes, or similar techniques may be installed. The applicant estimates that approximately 6 percent of the OECC route may require such additional measures (COP Volume I, Section 3.2.1; Epsilon 2022a). Given that most of the seabed in and near the proposed OECC is flat sand and silt, the addition of rock or concrete protection atop sections of the buried cable would change the nature of the seabed habitat. The applicant estimates that up to 22 acres within the OECC would need protection, although some of this could occur outside the geographic analysis area for coastal habitats and fauna. Approximately half of Phase 1 cable protection would be installed within 3 nautical miles (3.5 miles) of the high tide line (i.e., USACE jurisdiction under CWA Section 404 [Epsilon 2022b]). By adding hard surfaces, vertical relief, and habitat complexity, such changes could lead to increases in faunal diversity (Langhamer 2012; Taormina et al. 2018). However, benthic monitoring at the Block Island Wind Farm has found that mussels and other organisms have failed to colonize concrete mattresses. Other hard surfaces at Block Island Wind Farm have seen rapid growth by mussels and other organisms (BOEM 2019b). Placement of cable protection, especially in areas of natural hard-bottom habitat, may cause additional **minor** impacts in the areas affected by new cable emplacement and maintenance. The conversion of some abundant soft-bottom habitat to a rarer hard habitat, and the increase in faunal diversity that is likely to result, would be considered a **minor** beneficial impact (NOAA 2007), although the new habitat may or may not function similarly to hard-bottom habitat typical in the region (BOEM 2019b; 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 (BOEM 2019b). Either way, the level of aggregation or attraction associated with cable protection in coastal areas is anticipated to mainly occur at the individual level, not a population level. However, if the applicant installs protection atop existing hard/complex bottom habitat, alteration of that portion of the habitat could occur; the change in habitat quality at any one of those sites may be positive or negative (Sheehan et al. 2020). In any case, there would likely be a period of reduced ecological function during installation and for some time afterward as the processes of colonization and succession occurred on the new substrate (Sheehan et al. 2020). Considering that much of the proposed OECC is not hard/complex bottom, it is possible that cable protection would add more hard-bottom habitat area than would be damaged by the cable protection installation. Thus, the hard protection aspect of Phase 1 may result in a **minor** beneficial and **minor** impact on coastal habitats and fauna.

Estuarine coastal habitats associated with the Centerville River in the vicinity of the onshore export cable, especially salt marsh habitat, could be affected if trenchless crossing methods are infeasible and the applicant must use a utility bridge as the crossing method. If a utility bridge were installed, up to 42 square feet of habitat could be permanently altered by the presence of bridge pilings, which would likely become colonized by oysters (COP Volume III, Section 6.1.2.1; Epsilon 2022a).

BOEM could require as a condition of COP approval, that the applicant use only certain types of cable protection, as described in Appendix H. The use of natural materials and nature-inclusive designs would increase the probability of recolonization by benthic organisms and use of the introduced substrate as habitat. Therefore, this would reduce the degree of impacts from cable protection and enhance the degree of possibly beneficial impacts, although the level of impacts would remain the same.

Impacts of Phase 2

Phase 2 would involve similar components, activities, and types of potential impacts as Phase 1 but in different quantities and locations. The potential impacts from operations and decommissioning are the same for Phase 2 as for Phase 1. Therefore, the following analysis focuses on the differences between Phase 1 and Phase 2 construction.

If the applicant includes the SCV as part of the final proposed Project design, impacts associated with the SCV may occur either in place of or in addition to the impacts associated with the Phase 2 OECC through Muskeget Channel. Except where specifically discussed in this section, the impacts of the SCV in federal waters (3 miles or greater from shore) would have the same magnitude as those described for Phase 1. The portion of the SCV within 3 nautical miles (3.5 miles) of shore and onshore components of the SCV have not yet been defined. BOEM will provide a more detailed analysis of the impacts of the SCV and the Phase 2 OECC and OECR on coastal habitats and fauna in a supplemental NEPA analysis.

The potential impacts from accidental releases, EMF, light, noise, and climate change are the same for Phase 2 (with or without the SCV) as for Phase 1. The following IPFs could result in different impacts for Phase 2 than discussed for Phase 1.

Anchoring and gear utilization: The potential impacts of Phase 2 would be similar to those of Phase 1, except that Phase 2 would disturb up to 51 acres in the OECC (excluding areas affected by anchor sweep), some of which would occur outside the geographic analysis area for coastal habitats and fauna—that is, offshore of the 3-nautical-mile (3.5-mile) seaward limit defining coastal habitats (COP Volume I, Section 4.3.1.13; Epsilon 2022a). The **minor** to **moderate** incremental impact of anchoring under Phase 2 would result in temporary to permanent impacts on coastal habitats, depending on the nature of the habitat affected.

The applicant has not estimated the anchoring impacts from the SCV in federal waters; however, BOEM assumes that these impacts would be similar to those described for Phase 2 without the SCV.

Cable emplacement and maintenance: The potential impacts of Phase 2 would be similar to those of Phase 1, except that Phase 2 would use the Dowses Beach Landfall Site and/or Wianno Avenue Landfall Site in the Town of Barnstable (COP Volume I, Figure 4.1-6; Epsilon 2022a). Phase 2 would include two or three offshore export cables and one or more fiber optic cables for communication purposes. The maximum length of all Phase 2 offshore export cables (assuming three cables) is approximately 192 nautical miles (221 miles). Phase 2 would disturb up to an estimated 383 acres of seafloor within the OECC during cable installation (although some of these areas would lie outside of the geographic analysis area for coastal habitats and fauna). If detailed engineering or other technical issues arise demonstrating that installation of all Phase 2 cables within a portion of the main OECC in the Muskeget Channel is not feasible, the applicant would exercise the option to install one or two Phase 2 offshore export cables within the Western Muskeget Variant. The Western Muskeget Variant is the same corridor as the western Muskeget option evaluated in the Vineyard Wind 1 Final EIS (BOEM 2021b). Section 3.5.2.4 describes the potential impacts of various routing options using the Western Muskeget Variant.

Impacts on coastal habitats and fauna at the landfall site(s) would be avoided by locating the sea-to-shore transition vault in a paved area and, at the Dowses Beach Landfall Site, by using HDD to install the cable beneath the beach. The onshore export cable crossing of East Bay, if used, would use microtunneling, HDD, or other trenchless installation methods to pass beneath the bay and avoid impacts on coastal habitats. Neither approach to the Phase 2 landfall sites would pass near Spindle Rock's hard-bottom habitat and eelgrass bed.

The applicant only expects to use the Wianno Avenue Landfall Site if unforeseen challenges arise that make it infeasible to use the Dowses Beach Landfall Site to accommodate all of the Phase 2 offshore export cables. The cable(s) could be installed at this site using HDD or open trenching. The Wianno Avenue Landfall Site is suitable for open trenching because the shoreline consists of a riprap seawall, a portion of which would be temporarily removed to facilitate cable installation and replaced afterward (COP Volume I, Section 4.3.1.8.2; Epsilon 2022a). If open trenching is used, the process would involve installing cofferdam, removing riprap, dewatering, trenching within the cofferdam, installing conduit, backfilling, removing cofferdam, and replacing riprap. Regardless of the landfall site construction method used, the area of state-mapped eelgrass near the end of Wianno Avenue would be avoided.

The potential impacts of Phase 2 would be similar to those of Phase 1, except that total dredging for the installation of up to three export cables could impact up to 67 acres within the main OECC or up to 73 acres if the Western Muskeget Variant is used, although some of this would occur outside of the geographic analysis area for coastal habitats and fauna (COP Appendix III-P; Epsilon 2022a). Table 3.5-4 summarizes the distribution of dredging within state and federal waters (as defined in the discussion of Phase 1 impacts). The SCV would require up to 5 acres of dredging, potentially in addition to the protection for the main OECC or Western Muskeget Variant. The impacts would likely be **minor**.

Table 3.5-4: Phase 2 Impacts within U.S. Army Corps of Engineers Jurisdiction (Cubic Yards)

Habitat Type	**State Waters[a]**			**Federal Waters[a]**			**Total**		
Scenario[b]	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Dredge volume	91,500	124,900	131,100	144,000	144,000	143,800	235,400	268,800	274,800
Fluidized trench sediment volume[c]	217,538	211,358	205,178	0	0	0	217,538	211,358	205,178

Source: Epsilon 2022c

[a] State waters include open waters areas from the high tide line to 3 nautical miles (3.5 miles) from shore. Federal waters include open waters from the 3-nautical-mile limit to the seaward limit of the OCS.
[b] Scenario 1 includes three offshore export cables through the Eastern Muskeget route; Scenario 2 includes two cables in the Eastern Muskeget route and one in the Western Muskeget Variant; Scenario 3 includes one cable in the Eastern Muskeget route and two cables in the Western Muskeget Variant.
[c] The applicant assumed that an area up 1 meter (3.3 feet) wide and 1.5 meters (4.9 feet) deep may be fluidized during installation with a jet plow.

The potential sedimentation impacts of Phase 2 (with or without the SCV) would be similar to Phase 1, except that Phase 2 would not approach Spindle Rock's hard-bottom habitat and eelgrass bed. However, if an eelgrass bed exists south of the proposed OECC approaching the Wianno Avenue Landfall Site, as possibly indicated by proposed Project surveys (COP Volume III, Section 6.4.1.1.2; Epsilon 2022a), it may be vulnerable to sedimentation, which could affect habitat quality. The sediment transport modeling

(COP Appendix III-A; Epsilon 2022a) for the OECC was intended to be representative of Phase 1 or Phase 2; if the Western Muskeget Variant were selected, the area affected by sediment deposition would be similar to that affected if only the main OECC were used, due to the shorter length of the western route, although the maximum amount of dredging could be more (see the seabed profile alterations sub-IPF; COP Volume I, Section 4.3.1.3.5; Epsilon 2022a). As with Phase 1, impacts would likely be **negligible** to **minor**.

Installation of the SCV OECC would impact approximately 329 acres of seafloor beyond the 3-nautical-mile (3.5-mile) limit of territorial seas, including approximately 41 acres of hard protection for cables. The SCV would avoid hard-bottom habitats where feasible (Epsilon 2022a). As a result, the impact magnitudes for SCV cable installation would be the same as those described for Phase 2 without the SCV.

Presence of structures: The potential impacts of Phase 2 would be similar to those of Phase 1. The applicant estimates that approximately 6 to 8 percent of the OECC route may require cable protection measures, totaling up to 32 acres within the main OECC, up to 38 acres if the Western Muskeget Variant is used, although some of the cable protection could be placed outside the geographic analysis area for coastal habitats and fauna (COP Volume I, Section 4.3.1.13; Epsilon 2022a). Approximately half of the Phase 2 cable protection would be installed within 3 nautical miles (3 miles) of the high tide line (i.e., USACE jurisdiction under CWA Section 404 Epsilon 2022b]). The SCV would require up to 41 acres of cable protection, potentially in addition to the protection for the main OECC or Western Muskeget Variant (Epsilon 2022a). Phase 2 would not add any new structures in estuarine coastal habitats. The hard protection could result in a **minor** beneficial and **minor** impact on coastal habitats and fauna. Phase 2 would cause local and **minor** beneficial impacts and **minor** impacts on coastal habitats and fauna through this IPF.

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-2 in Appendix G would contribute to impacts on coastal habitats and fauna through the primary IPFs of anchoring and gear utilization, cable maintenance and emplacement, and climate change. These impacts would primarily occur through seafloor disturbance, sedimentation, and dredging. The impacts of Alternative B would only overlap with other ongoing and planned activities where cables from the Mayflower Wind Project cross the cables from the proposed Project, or where seafloor disturbance and sedimentation from the proposed Project affects the same area previously affected by installation of the Vineyard Wind 1 OECC. As a result, the cumulative impacts on coastal habitats and fauna would be **minor** to **moderate** and **minor** beneficial.

Conclusions

Impacts of Alternative B. Alternative B would have **minor** to **moderate** impacts and **minor** beneficial impacts on coastal habitats and fauna within the geographic analysis area based on all IPFs. Short-term impacts from anchoring and gear utilization and cable emplacement and maintenance (especially if dredging occurs) could lead to habitat and species disruption during construction and decommissioning. Impacts during operations would be less frequent and less extensive. Beneficial impacts would result from the reef effect from hard protection areas.

The applicant has committed to performing monitoring during and after construction for examining the disturbance and recovery of coastal and benthic habitats (COP Appendix III-U; Epsilon 2022a) in the proposed Project area. Although this would involve localized disturbances of the seafloor habitat, the results would provide an understanding of the proposed Project’s impacts, which would benefit future management of coastal resources in this area and could inform planning of other offshore developments. While the level of most impacts would remain the same, BOEM is evaluating the following mitigation and monitoring measures to address impacts on coastal habitats and fauna, as described in detail in Table H-2 of Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

- Require an anchoring plan, potentially in combination with additional habitat characterization, to avoid anchoring in sensitive habitats to the maximum extent practicable;
- Restrict dredging and cable installation methods and timing, potentially in combination with additional habitat characterization, to reduce the degree of dredging and cable installation impacts;
- Require that cable protection measures within hard-bottom habitat as defined in the COP and the EFH assessment must use natural or engineered stone that does not inhibit epibenthic growth to increase the potential use of the introduced substrate as habitat; and
- Restrict dredge disposal sites to minimize impacts on sensitive habitats.

While monitoring would not reduce impacts of Phase 1, BOEM could evaluate impacts, refine current knowledge of coastal habitats and fauna, and inform the applicant’s decommissioning procedures, as well as planning similar future projects, to assist in selecting the least impactful method(s). BOEM may require the following monitoring measures conditioned as part of the COP approval (Appendix H):

- Conduct pre- and post-installation bottom profiling and video monitoring along the offshore export cable route; and
- Provide additional review and comment on the benthic monitoring plan.

Cumulative Impacts. The cumulative impacts on coastal habitats and fauna in the geographic analysis area would be **minor** to **moderate** and **minor** beneficial. Cumulative impacts on coastal habitats and fauna would primarily occur during construction, especially where proposed Project construction overlaps spatially or temporally with construction of the Vineyard Wind 1 or Mayflower Wind projects. Alternative B would also have long-term and **minor** beneficial impacts from conversion of some abundant soft-bottom habitat to a rarer hard habitat, where scour and cable protection is installed, which would result in an associated increase in faunal diversity. The impact ratings include the short-term and **minor** to **moderate** impacts during construction from anchoring and gear utilization and cable emplacement and maintenance (specifically dredging), as well as the long-term and **minor** beneficial impacts associated with the presence of structures and cable emplacement and maintenance, specifically where hard cover and cable protection are installed.

3.5.2.4 Impacts of Alternative C – Habitat Impact Minimization Alternative on Coastal Habitats and Fauna

Alternatives C-1 and C-2, summarized below, would limit the number of export cables installed in the Eastern Muskeget route or Western Muskeget Variant but would not affect the number or placement of WTGs or ESPs for the proposed Project, compared to Alternative B. All other proposed Project components, including construction, operations, and decommissioning, would be identical to Alternative B:

- Alternative C-1 would avoid impacts on complex habitats in the Western Muskeget Variant by removing that route as an option for Phase 2. Under this alternative, all three Phase 2 export cables would be installed in the Eastern Muskeget route, as well as both cables for Phase 1.

- Alternative C-2 would limit the number of export cables installed in the Eastern Muskeget route to three (both Phase 1 cables and one Phase 2 cable) and would include installation of up to two cables in the Western Muskeget Variant. This would reduce impacts on complex habitats in the Eastern Muskeget route.

Alternatives C-1 and C-2 would reduce or avoid impacts on coastal habitats and fauna (compared to Alternative B) during construction, operations, and decommissioning in either the Western Muskeget Variant or Eastern Muskeget route. This would reduce the impacts from the IPFs described for Alternative B in Section 3.5.2.3, in the specific area avoided.

The Western Muskeget Variant would affect less seafloor acreage than the Eastern Muskeget route; however, the Western Muskeget Variant is comprised of complex seafloor only, while the Eastern Muskeget route is comprised of complex seafloor, hard coarse deposits, and soft bottom. Because of the rare habitats provided by complex and hard coarse deposit seafloor types, avoidance of disturbance of these habitats would also result in lower impacts on coastal habitats and fauna (additional discussion is provided in Section 3.4.2.4).

Alternative C-1 would use only the Eastern Muskeget route, which would eliminate impacts on coastal habitats and fauna in the Western Muskeget Variant. The Eastern Muskeget route contains more types of habitat than the Western Muskeget Variant but less of the habitat is complex seafloor. Using only the Eastern Muskeget route in Alternative C-1 would, therefore, impact more habitat types and a wider variety of species inhabiting these habitats than if the Western Muskeget Variant were used. However, Alternative C-1 would impact less of the complex habitat compared to Alternative B (which includes the potential use of the Western Muskeget Variant).

Alternative C-2 could use both the Eastern Muskeget route and the Western Muskeget Variant, impacting coastal habitats and fauna in complex seafloor, hard coarse deposits, and soft bottom habitats across a larger area than Alternative C-1. Under Alternative C-2, dredging for Phase 2 cable installation could impact up to 73 acres and include up to 274,800 cubic yards of dredged material (compared to 67 acres and 235,400 cubic yards for Alternative B and Alternative C-1). Because Alternative C-2 would involve installation of fewer cables in the Eastern Muskeget route, the impacts of Alternative C-2 on coastal habitats and fauna in the Eastern Muskeget route would be less than those under Alternative C-1, and potentially less than those of Alternative B because Alternative C2 would involve installation of fewer cables in the Eastern Muskeget route. The impacts of Alternative C-2 on coastal habitats and fauna in the Western Muskeget Variant would be greater than Alternative C-1, due to the installation of up to two cables in that corridor (where no such cables would be installed under Alternative C-1 and most scenarios of Alternative B, as shown in Table 2.1-2 in Chapter 2, Alternatives). Overall, Alternative C-2 would have greater impacts than Alternative C-1on coastal habitats and the fauna found in complex seafloor habitats due to impacts within both the Eastern and Western Muskeget.

Overall, similar to Alternative B, the impacts of Alternatives C-1 and C-2 on coastal habitats and fauna would remain **minor** to **moderate** and **minor** beneficial. Although Alternative C-1 would result in a slightly shorter cable route due to use of the Eastern Muskeget route compared to cable placement in both the Eastern Muskeget route and the Western Muskeget Variant in Alternative C-2, the differences in route length are not expected to result in a difference of potential impacts on coastal habitats and fauna. The cumulative impacts from ongoing and planned activities, including Alternatives C-1 and C-2, would be similar to those of Alternative B: **minor** to **moderate** and **minor** beneficial.

3.6 Finfish, Invertebrates, and Essential Fish Habitat

3.6.1 Description of the Affected Environment

3.6.1.1 Geographic Analysis Area

This section discusses existing finfish and invertebrate resources and their respective designated EFH in the geographic analysis area, as defined in Table D-1 in Appendix D, Geographical Analysis Areas, and illustrated on Figure 3.6-1. Specifically, the geographic analysis area for finfish, invertebrates, and EFH spans the southern New England subregion of the Northeast U.S. Continental Shelf Large Marine Ecosystem (LME), which extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina. The northern portion of the geographic analysis area includes only U.S. waters (Figure 3.6-1). Although EFH and most benthic invertebrates could be affected by the proposed Project and other activities only within the proposed Project area and a small distance beyond, migratory species and planktonic life stages of finfish and invertebrates could also be affected by other factors when the species move elsewhere within the broader geographic analysis area.

The following are agencies, commissions, councils, and regulations responsible for managing the finfish, invertebrates, and EFH in the geographic analysis area:

- The Atlantic States Marine Fisheries Commission (ASMFC) is responsible for managing or co-managing 27 coastal shellfish, marine, and diadromous fish species in state waters in cooperation with NOAA (ASMFC 2018).
- The New England and Mid-Atlantic Fishery Management Councils manage a total of 40 species in federal waters in cooperation with NOAA.
- NOAA uses a single Fisheries Management Plan (FMP) under the MSA (NOAA 2021) to manage 43 Atlantic highly migratory species (HMS) in the Exclusive Economic Zone, which extends from the 3-nautical-mile (3.4-mile) limit to the 200-nautical-mile (230-mile) limit.
- Section 7(a)(2) of the ESA requires federal agencies to ensure that any action they authorize, fund, or carry out is unlikely to jeopardize an endangered or threatened species, in consultation with the relevant agency(ies). NOAA has identified 4 listed species and 15 candidate species or species of concern as potentially occurring in the SWDA and OECC (BOEM 2019c).
- Section 305(b)(2) of the MSA requires federal agencies to consult with NMFS regarding any of their actions authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken that may adversely affect EFH (50 CFR § 600.920).

3.6.1.2 Existing Conditions

The proposed Project area is located south of Cape Cod in the northern Mid-Atlantic Bight (MAB), part of the Northeast U.S. Continental Shelf LME (Figure 3.6-1). The benthic habitat in the SWDA is predominantly flat with sand or sand-dominated substrate that becomes increasingly muddy toward the south end of the SWDA and increasingly gravelly toward the northwest corner (COP Volume II, Section 2; Epsilon 2022a). The northern MAB supports a diverse finfish and invertebrate assemblage (COP Volume I, Section 3.3.1 and Volume III, Section 6.6.1; Epsilon 2022a). Additional descriptions of fish and invertebrate species in the proposed Project area can be found in other BOEM EISs for offshore wind projects in the region (BOEM 2012a, 2012b, 2014a). The Programmatic EIS for Alternative Energy Development (MMS 2007) also describes the affected environment for this section of the OCS.

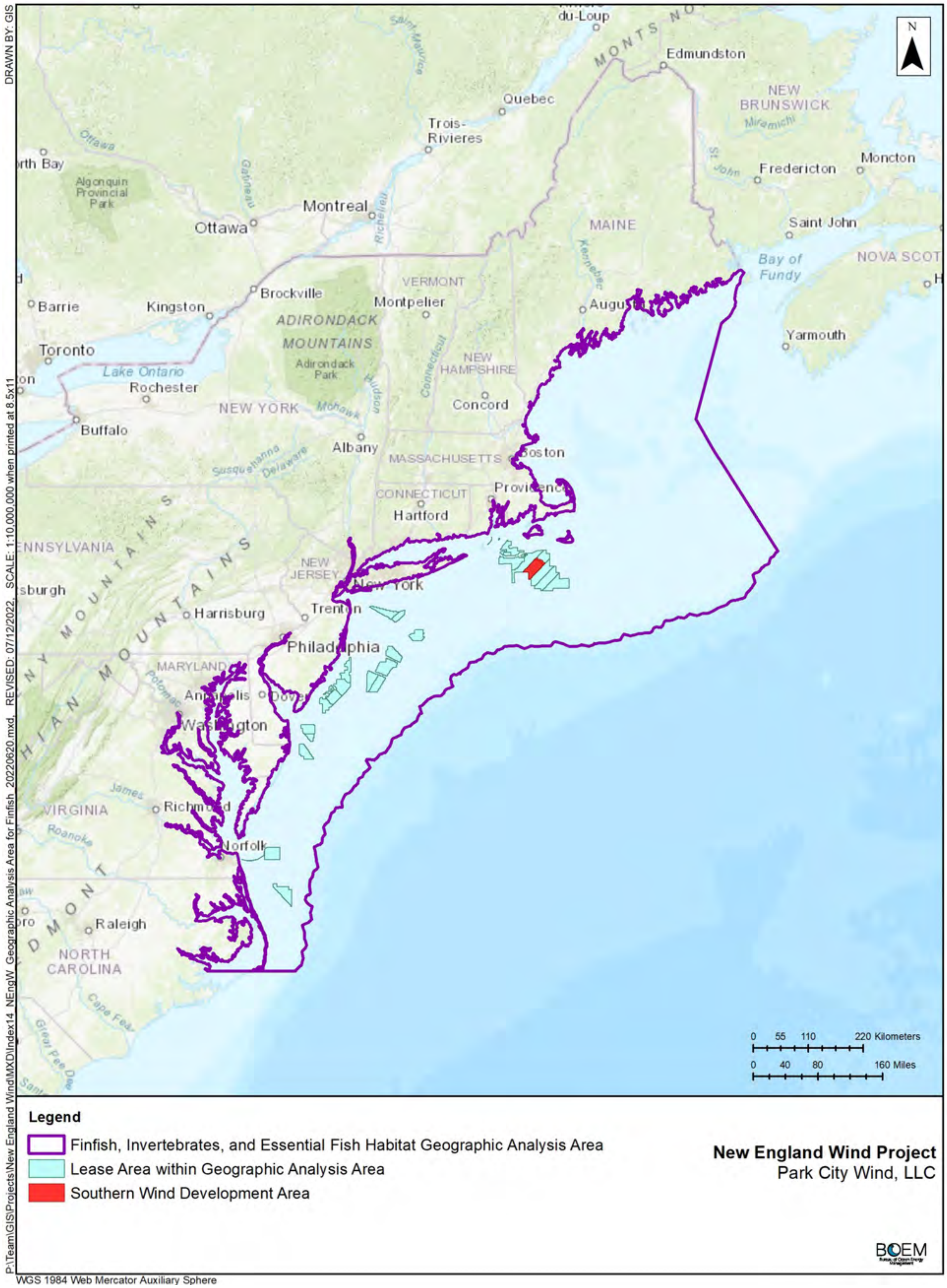


Figure 3.6-1: Geographic Analysis Area for Finfish, Invertebrates, and Essential Fish Habitat

The finfish that inhabit the proposed Project area located within the southern New England subregion are a mix of demersal, pelagic, and HMS with boreal, cold temperate, and warm temperate affinities. This subregion differs from others in productivity, species assemblages and structure, and habitat features (Cook and Auster 2007). The COP (Volume III, Table 6.6-1; Epsilon 2022a) lists 87 species of finfish and invertebrates that have been collected within the region and within the SWDA. The species list was prepared from various sampling efforts using mainly trawl sample data collected by the Northeast Fisheries Science Center (NEFSC) since 1977 and data collected during the University of Massachusetts Dartmouth SMAST fisheries surveys for Vineyard Wind 1 (Bethoney et al. 2019; COP Volume III, Section 6.6.1; Epsilon 2022a; Stokesbury et al. 2020).

The main demersal fishes found in the region are either shallow or intermediate finfish assemblages (Overholtz and Tyler 1985; BOEM 2014a). These demersal finfish are represented at the family level, by skates, dogfishes, requiem sharks, sea robins, hakes, anglerfishes, sculpins, seabasses, drums, tautog, scup (*Stenotomus chrysops*), and flatfishes. The scup uses both demersal and pelagic habitats and is designated to both habitat resources. The demersal species listed also include commercially and recreationally important species such as spiny dogfish (*Squalus acanthias*), skates, Atlantic cod (*Gadus morhua*), butterfish (*Peprilus triacanthus*), flounders, scup, black sea bass (*Centropristis striata*), silver hake (*Merluccius bilinearis*), and tautog (*Tautoga onitis*). Many of the demersal species listed are NMFS-managed and have EFH designations. These species have defined habitat and forage preferences and life history characteristics outlined in the EFH assessment for the proposed Project (BOEM 2022c). Information concerning the commercially and recreationally important demersal species can be found in Section 3.9, Commercial Fisheries and For-Hire Recreational Fishing.

Pelagic species found in the geographic analysis area are represented by 31 species listed in Table 6.6-1 of the COP (Volume III, Section 6.6.1; Epsilon 2022a). These species represent a diverse suite of finfish families including sharks, herrings, mackerels, cobia, striped bass, bluefish, and butterfishes. Many coastal pelagic species rely on coastal wetlands, seagrass habitats, and estuaries to provide habitat for specific life stages, and many of these species migrate north and south along the Atlantic Coast during some periods of the year. In general, movement is related to sea surface temperature. These fishes use the highly productive coastal waters within the Atlantic region during the summer months and migrate to deeper and/or more distant waters for the rest of the year. General patterns include cross-shelf movements to offshore spawning areas, movements along the shelf to southerly spawning areas, and movements between coastal rivers and the coastal ocean for spawning or the reverse (diadromy) (BOEM 2015; Jacobs Engineering Group Inc. 2019; COP Volume III, Section 6.6.1; Epsilon 2022a).

HMS often migrate from southern portions of the South Atlantic to as far north as the Gulf of Maine. Migrations are correlated with sea surface temperature, and these species generally migrate to northern waters in the spring, where they remain to spawn or feed until the fall or early winter (COP Volume III, Section 6.6.1; Epsilon 2022a). Examples of these species with ranges that overlap the SWDA include Atlantic bluefin tuna (*Thunnus thynnus*) and basking shark (*Cetorhinus maximus*).

Studies identifying the most prevalent species regionally include the 2003 to 2016 NEFSC bottom trawl surveys as summarized in Guida et al. (2017) and trawl surveys (1978 to 2018) conducted by the Massachusetts Division of Marine Fisheries (MA DMF). The NEFSC identified 101 taxa, including 40 managed species (Guida et al. 2017). Dominant species in both cold (winter/spring) and warm seasons (fall) included little skate (*Leucoraja erinacea*), winter skate (*Leucoraja ocellata*), and silver hake. Summer/fall dominant species included longfin squid (*Doryteuthis pealeii*), spiny dogfish, red hake (*Urophycis chuss*), butterfish, and scup, while winter dominant species included Atlantic herring (*Clupea harengus*) (Guida et al. 2017). All these species have designated EFH within the region (BOEM 2014a). Large bivalves, such as Atlantic surf clams (*Spisula solidissima*), Ocean quahog (*Arctica islandica*), and Atlantic sea scallops (*Placopecten magellanicus*), are also present, although their abundances are less well known (Powell and Mann 2016; Powell et al. 2017; SMAST 2016b); however, recent assessments indicate that none of these three species is currently subject to overfishing or in an overfished condition (MAFMC 2020a, 2020b; NEFSC 2018a).

The American lobster (*Homarus americanus*) (southern New England stock) is present in this region, and the waters south of Massachusetts contain important commercial lobster fishing grounds. However, catches in southern New England have declined sharply since the late 1990s, with the largest declines occurring in the inshore fishery (Figure 1.1 in ASMFC 2015a; this figure shows statistical area 538, which includes large portions of the OECC, and statistical areas 539 and 611, which are outside of the SWDA and OECC). The commercial importance of other species, like whelks (*Buccinum undatum*) and Jonah crab (*Cancer borealis*), has increased with the decline of the American lobster fishery, with Massachusetts accounting for 68 percent of the 15 million pounds of Jonah crab landed in 2016 (ASMFC 2015b). More than 70 percent of the Jonah crab catch in southern New England came from the region that includes portions of the SWDA and OECC (statistical area 537 of Figure 4 in ASMFC 2015b). Jonah crab are typically associated with rocky habitats and soft sediment, while lobster prefer hard-bottom habitat (ASMFC 2015a; Collie et al. 2019). Atlantic horseshoe crab (*Limulus polyphemus*) stocks are in decline (ASMFC 2013). According to the MA DMF (2016b, 2018), nesting Atlantic horseshoe crabs use Covell’s Beach from late spring to early summer.

MA DMF identified a total of 85 species (or higher taxa) during spring sampling (1978 to 2018) and 115 taxa during fall sampling (1978 to 2017). The top five most commonly encountered species in spring samples based on percent occurrence in descending order were spider crabs, longfin squid, winter flounder (*Pseudopleuronectes americanus*), windowpane flounder (*Scophthalmus aquosus*), and northern sea robin (*Prionotus carolinus*). During fall sampling, the most commonly encountered species were scup, longfin squid, butterfish, black sea bass, and spider crabs (Camissa, Pers. Comm., July 25, 2018).

HMS with ranges overlapping the SWDA and OECC are identified and described in BOEM (2014a) and in Epsilon 2022a (Volume III, Section 6.6.1.1). Several of these HMS have designated EFH within the SWDA and OECC (COP Appendix III-F, Section 4.0; Epsilon 2022a). NEFSC captured a total of 71 taxa during the winter/spring trawl and 81 taxa in the summer/fall trawl (Guida et al. 2017), indicating the SWDA is located within an area of relatively high species richness (COP Volume III, Figure 6.6-1; Epsilon 2022a). Biomass is low across the SWDA in spring but is high during the fall (COP Volume III, Figure 6.6-2; Epsilon 2022a).

The finfish and invertebrate resources identified in the MA DMF OECC trawl surveys vary seasonally, with commercial species like longfin squid and winter flounder more prevalent in the spring; and scup, longfin squid, and butterfish more commonly captured in the fall (Camissa, Per. Comm., July 25, 2018). Longfin squid occurred in 89.6 percent of the spring surveys (1978 to 2018) and in 99.7 percent of the fall surveys (1978 to 2007). Longfin squid are typically most abundant in southern New England in the spring through fall, whereas shortfin squid juveniles are typically found in spring and summer (BOEM 2014a). Longfin squid in this region spawn throughout the summer and early fall (MA DMF 2020). Longfin squid egg mops, which are demersal, were more prevalent during spring surveys (8.2 percent occurrence) than in fall surveys (5.5 percent occurrence) (Camissa, Per. Comm., July 25, 2018). Egg mop mapping by MA DMF indicates that egg mops are routinely identified along the OECC route (COP Volume III, Section 6.6, Figures 6.6-10, 6.6-11; Epsilon 2022a).

3.6.1.3 Essential Fish Habitat

The MSA requires federal agencies to consult on activities that may affect EFH identified in FMP. In the northern region on the MAB, NMFS works with the New England Fishery Management Council, the Mid-Atlantic Fishery Management Council (MAFMC), and the South Atlantic Fishery Management Council, and the Atlantic Office of Highly Migratory Species to define EFH for managed species within

New England waters. As presented in the EFH assessment (BOEM 2022c), 48 federally managed finfish and invertebrate species have at least one life stage with EFH within the SWDA and OECC (COP Appendix III-F, Section 4.0; Epsilon 2022a). Both substrate and water habitats are cited as EFH within both the SWDA and OECC. The EFH assessment provides a formal EFH assessment including relevant managed species within each of the fishery management councils within the proposed Project SWDA and OECC.

Three basic marine habitat types occur in the region: pelagic (water column), soft bottom, and hard bottom. In inshore waters, additional biogenic habitats such as emergent vegetation, submerged vegetation, and oyster reefs are important. Various managed species use these inshore habitats for shelter, feeding, growth, and reproduction. The northern MAB pelagic habitats support longfin inshore squid (*Doryteuthis pealeii*) and northern shortfin squid (*Illex illecebrosus*); coastal pelagic fishes such as Atlantic mackerel (*Scomber scombrus*), Atlantic herring, butterfish, bluefish (*Pomatomus saltatrix*), and spiny dogfish; and oceanic pelagic fishes such as tunas, swordfish (*Xiphias gladius*), and sharks. Members of the oceanic pelagic group (e.g., HMS) can span the entire geographic analysis area through migratory, feeding, and reproductive activity (NMFS 2006, 2017). Within this group, NMFS has developed FMPs for 12 Atlantic species that can range from the South Atlantic Bight up into the northern MAB on a seasonal basis (NMFS 2017; BOEM 2015).

Managed soft-bottom demersal species include Atlantic surf clam, Atlantic sea scallop, and ocean quahog. Soft-bottom fishes with EFH in the proposed Project area include summer flounder (*Paralichthys dentatus*), scup, monkfish (*Lophius americanus*) and spiny dogfish and a suite of species included in the New England Fishery Management Council’s Northeast Multispecies (groundfish) FMP. The NEFSC plan includes 12 soft-bottom species that are generally found within the Gulf of Maine and Georges Bank, but the range for some of these managed species can extend from Cape Hatteras, North Carolina, to the U.S./Canada border and beyond. The three most valued species within this group include Atlantic cod, haddock (*Melanogrammus aeglefinus*) and the yellowtail flounder (*Pleuronectes ferruginea*).

Black sea bass is an example of a hard-bottom species with EFH in the proposed Project area. Inshore habitats provide shelter for early life stages of summer flounder, striped bass (*Morone saxatilis*), bluefish, weakfish (*Cynoscion regalis*), black seabass, and scup. All major MAB habitats will produce prey such as benthic invertebrates, anchovies, silversides, herrings, and sand lances, which are important to many managed species (Kritzer et al. 2016).

Fish species that might occur within the SWDA and OECC and that are listed under the ESA include the giant manta ray (*Manta birostris*), Atlantic salmon (*Salmo salar*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), and the shortnose sturgeon (*Acipenser brevirostrum*) (BOEM 2022c). More information on these ESA-listed species may be found in the Biological Assessment (BA) for the proposed Project (BOEM 2022d).

The fishery management councils also identify habitat areas of particular concern (HAPC). HAPCs are discrete subsets of EFH that provide important ecological functions or are especially vulnerable to degradation. No HAPCs are located within the SWDA, although HAPCs for summer flounder and juvenile Atlantic cod occur within the OECC.

Listed Endangered Species

Fish species that might occur within the SWDA and OECC and that are listed under the ESA and identified by NOAA (NOAA 2022a) to be within the New England/MAB distinct population segments (DPS) include the giant manta ray, oceanic whitetip shark (*Carcharhinus longimanus*) Atlantic salmon, Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), and shortnose sturgeon (BOEM 2022c, NOAA

2022a, 2022b]). More information on these ESA-listed species may be found in the BA for the proposed Project (BOEM 2022d).

Trends

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 2000s, the majority of commercially exploited stocks within the geographic analysis area were categorized as overfished. An overfished conditioned means that the fisheries harvest is at a rate that surpasses its ability to replenish the population at a maximum sustainable yield (NMFS 2021c).

A 2015 assessment of 20 groundfish species in the southern New England subregion indicates that while the number of overfished stocks has generally decreased, depletion continues for certain stocks (NEFSC 2015). In particular, winter flounder, yellowtail flounder, and Atlantic wolffish (*Anarhichas lupus*) remain overfished (NEFSC 2015). Recent assessments indicate that 17 fish stocks are currently overfished, while another 5 stocks are subject to overfishing, meaning that the harvest rate exceeds the maximum sustainable yield (NMFS 2021c). Stock assessments for the American lobster within southern New England have demonstrated a precipitous decline since the early 2000s (ASMFC 2020). Lobster fisheries in the Gulf of Maine and Georges Bank are considered in good standing, although the lobster fishery in southern New England is considered depleted but not overfished. This may be indicative of the overall population trend of fish stocks; however, 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).

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). Commercial and recreational fishing results in mortality of finfish and invertebrates through harvest and bycatch of undersized individuals or non-target species. 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.

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. Ongoing impacts resulting from fishing pressure, especially via dredging and bottom-trawling gear, will continue regardless of the offshore wind industry. 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 activities, such as pipeline trenching or submarine cable emplacement that create a relatively narrow trench and backfill in the same operation. See Section G.2.2 for more information on water quality.

Recent NMFS recovery programs have returned some fisheries stocks to stable levels within the geographic analysis area, but assessments of fisheries distributions have shown shifts of species ranges related to warming trends within the mid-Atlantic (NMFS 2021d). For example, unseasonably high water temperatures resulting from a shift in the Gulf Stream toward the New England coast and elevated pH levels in southern New England and MAB have caused a shift in the distribution of surf clam and ocean quahogs (NMFS 2021d). The ranges of both species have begun to overlap, with surf clam and ocean quahog distributions moving into deeper water and trending to the northeast (NMFS 2021d). Regional water temperatures that increasingly exceed the thermal stress threshold (20°C) may affect the recovery of the American lobster stock (ASMFC 2015a). Impacts on finfish, invertebrates, and EFH depend on many factors but can be widespread and permeant due to climate change.

Invasive species are periodically released accidentally during ongoing activities, including the discharge of ballast water and bilge water from marine vessels; the resulting 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.

3.6.2 Environmental Consequences

Definitions of impact levels for finfish, invertebrates, and EFH are described in Table 3.6-1.

Table 3.6-1: Impact Level Definitions for Finfish, Invertebrates, and Essential Fish Habitat

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

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

When analyzing the impacts of Alternative A on finfish, invertebrates, and EFH, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on existing conditions for finfish, invertebrates, and EFH (Table G.1-3 in Appendix G, Impact-Producing Factor Tables and Assessment of Resources with Minor [or Lower] Impacts). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for finfish, invertebrates, and EFH described in Section 3.6.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on finfish, invertebrates, and EFH include increasing vessel traffic; new submarine cables and pipeline; increasing onshore construction; marine surveys; marine minerals extraction; port expansion; channel-deepening activities; beach nourishment projects; the installation of new towers, buoys, and piers; and construction of approved offshore wind projects such as Vineyard Wind 1, Revolution Wind, and others listed in Appendix E.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than

Alternative B). Future offshore wind development activities would affect finfish, invertebrates, and EFH through the following primary IPFs.

Accidental releases: Accidental releases may increase as a result of future offshore wind activities. As discussed in Section G.2.2, Water Quality, releases could expose coastal and offshore waters to contaminants in the event of a spill or release during routine vessel use, collisions and allisions, or equipment failure of a WTG or ESP. 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 2,955 WTGs and ESPs under Alternative A collectively hold approximately 119 million gallons of fuel/fluids/hazardous materials contained in all offshore wind facilities. The risk of a release from any one of these structures would be low. A release of 128,000 gallons is likely to occur no more often than once per 1,000 years, and a release of 2,000 gallons or less is likely to occur every 5 to 20 years (Bejarano et al. 2013). 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 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. Invasive species becoming established as a result of offshore wind activities is possible. As documented in observations of colonial sea squirt (*Didemnum vexillum*) at the Block Island Wind Farm (HDR 2020b), the impacts of invasive species on finfish, invertebrates, and EFH could be strongly adverse, widespread, and permanent if the species were to become established and out-compete native fauna or modify habitat. The increase in this risk related to the offshore wind industry would be small in comparison to the risk from ongoing activities. For example, colonial sea squirt is already an established species in New England with documented occurrence in subtidal areas, including on Georges Bank, where numerous sites within a 56,834-acre area are 50 to 90 percent covered by colonial sea squirt (Bullard et al. 2007).

Trash and debris accidentally released into the marine environment can harm marine animals through entanglement and ingestion. These releases would be infrequent because operators would comply with federal and international requirements for management of shipboard trash, and the extent of an accidental release would be limited to the localized area.

Overall, accidental releases are anticipated to be short term and localized and 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, with the exception of invasive species, which could cause permanent alterations to the ecosystem.

Anchoring and gear utilization: Ongoing and planned offshore wind activities are likely to include monitoring surveys in the offshore wind lease areas. These could include acoustic, trawl, and trap surveys, as well as other methods of sampling the biota in the area. The presence of monitoring gear could affect finfish, invertebrates, and EFH by entrapment, entanglement, or seafloor disturbance; however, it is expected that monitoring plans would have sufficient mitigation procedures in place to reduce potential impacts. Impacts from gear utilization from other offshore wind activities are expected to occur at short-term, regular intervals over the lifetime of the projects and have no perceptible consequences to individuals, populations, or habitat. However, the potential extent of potential impacts cannot be determined without proposed Project-specific information. Vessel anchoring can cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. Alternative A could also include increased anchoring and mooring of met towers or buoys. Anchoring would cause increased turbidity levels and 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). Alternative A would include increased vessel anchoring during survey activities and construction, maintenance, and decommissioning of offshore components. Anchoring of vessels under Alternative A during cable installation could affect up to approximately 3,836 acres beginning in 2022 and continuing through 2030 and beyond. All impacts would be localized, turbidity would be temporary, and mortality from physical contact would be recovered in the short term. Degradation of sensitive habitats, if it occurs, could be long term to permanent. 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 contact a portion of seafloor affected by an earlier anchor or chain.

Cable emplacement and maintenance: Cable emplacement and 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) activities occur. This IPF would cause impacts during construction. Assuming other offshore wind projects use installation procedures similar to those described for the proposed Project (COP Volume I, Section 3.3.1.3; Epsilon 2022a), the extent of impacts would be anticipated to include an up to 3.3-foot-wide cable installation trench and an up to 10-foot-wide temporary disturbance zone from the skids/tracks of the cable installation equipment. Finfish, invertebrates, and most EFH would recover following disturbance, although some habitats would not fully return to their previous conditions (Hemery 2020). The cable routes for future offshore wind projects have not been fully determined at this time. Cables for other future offshore wind projects within the geographic analysis area are anticipated to occur over the next 8 years and beyond. The total area of seafloor disturbed by cable emplacement for offshore wind facilities is estimated to be up to 63,840acres (Appendix E). The geographic analysis area for finfish, invertebrates, and EFH contains over 16 million acres of gravel or hard bottom, over 46 million acres of sand bottom, and over 15 million acres of silt/mud bottom (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. Short-term impacts 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 HAPCs including, but not limited to, eelgrass and hard-bottom habitats may cause long-term to permanent impacts on those resources; otherwise, impacts of habitat disturbance and mortality from physical contact would be recovered in the short term.

In addition to the impacts discussed above, dredging for cable installation can cause localized and short-term impacts (habitat alteration, change in complexity) on finfish, invertebrates, and EFH through seabed profile alterations, as well as sediment deposition and burial. The magnitude of impacts from seabed profile alterations would 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. Locations, amounts, and timing of dredging for future offshore wind projects are not known at this time. The need for dredging depends on local seafloor conditions; assuming the areal extent of such impacts is proportional to the length of cable installed, 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. 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, although full recovery of faunal assemblage may require several years (Boyd et al. 2005). Therefore, seabed profile alterations, while locally intense, would have little impact on finfish, invertebrates, and EFH on a regional scale.

Dredged material disposal during construction would cause temporary, localized turbidity increases and long-term sedimentation or burial at the immediate disposal site. Cable emplacement and maintenance activities (including dredging) during construction or operations 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 (i.e., habitat type). The cable routes for future projects within the geographic analysis area have not been fully determined but would be emplaced over the next 8 years and beyond. Locations, amounts, and timing of dredging for future offshore wind projects are not known at this time. Assuming the areal extent of sediment deposition and burial impacts is proportional to the length of cable installed (Appendix E), Alternative A (excluding the proposed Project) would result in 374,010 acres of light sedimentation (up to 0.04 inch deep).[12] Increased sediment deposition may occur during multiple years. The area with a greater sediment deposition from simultaneous or sequential activities would be limited, as most of the impacted areas would only be lightly sedimented 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 (Gaichas et al. 2015; 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 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 (Brothers et al. 2016; Hoegh-Guldberg and Bruno 2010). CO_2 emissions also cause ocean acidification, possibly contributing to reduced growth or the decline of invertebrates that have calcareous shells (PMEL 2020). See Section G.2.1, Air Quality, for details on the expected contribution of offshore wind activities to climate change.

EMF: Biologically significant impacts on finfish, invertebrates, and EFH have not been documented for EMF from 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 (skate and lobster) near operating direct current cables (Hutchison et al. 2018, 2020). The impacts are localized and affect the animals only while they are within the EMF. There is no evidence to indicate that EMF from submarine AC power cables affects commercially and recreationally important fish species within the southern New England area (CSA Ocean Sciences, Inc. and Exponent 2019). A recent review concludes that research has demonstrated responses to EMF in various species but not at the EMF strengths involved in marine renewable energy projects (Gill and Desender 2020). Operating cables related to future offshore wind activities other than the proposed Project would produce EMF to some degree. The submarine cable routes for those projects have not been determined at this time. Alternative A would result in up to 6,552 miles of offshore export, inter-array, and inter-link cable added to the geographic analysis area, producing EMF in the immediate vicinity of each submarine cable.

Submarine cables in the geographic analysis area are assumed to be installed with appropriate shielding and/or burial depth to reduce potential EMF to low levels. EMF of any two sources would not overlap

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[12] The Sediment Transport Modeling Report for the proposed Project (COP Appendix III-A, Table 20; Epsilon 2022a) assumed deposition of up to 0.04 inch of sediment across approximately 2,740 acres for an assumed 48.0-mile export cable, or approximately 57.1 acres per linear mile. For the 6,552 miles of export cable assumed in Alternative A, this equates to approximately 374,010 acres of light sedimentation.

(except where cable cross each other) because developers typically allow at least 330-foot spacing between cables (even for multiple cables within a single OECC), EMF strength diminishes rapidly with distance, and potentially significant EMF would likely extend less than 50 feet 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 negligible 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). EMF does not appear to constitute a barrier to migration (Kavet et al. 2016). Although the EMF would exist as long as a submarine cable was in operation, impacts on finfish, invertebrates, and EFH would likely be biologically insignificant.

Lighting: Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light can also disrupt natural cycles such as spawning. Offshore wind development would result in additional light from vessels and offshore structures. Downward-directed deck lighting would have a much greater effect than the navigational lights required on vessels or structures. Vessels would be lit during construction, operations, and decommissioning and would follow BOEM lighting guidelines. The impact of lighting from Alternative A would likely be small relative to non-wind industry activities. In a maximum-case scenario, vessel lights could be active 24 hours per day during construction. This lighting could attract finfish and invertebrates to construction zones, potentially exposing them to greater harm from other IPFs (e.g., noise).

Under Alternative A, up to 2,955 WTGs and ESPs (constructed incrementally from 2022 to 2030 and beyond) would have navigation and/or aviation hazard lights during operations in accordance with BOEM’s lighting and marking guidelines. 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 is not likely to affect finfish, invertebrates, and EFH.

Noise: Noise from construction, pile driving, G&G survey activities, aircraft, trenching, operations, vessels, and decommissioning could contribute to impacts on finfish, invertebrates, and EFH. Pile-driving noise would have the greatest impact.

Alternative A would include construction of up to 2,955 WTGs and ESPs and would create noise—including pile driving—that affects finfish, invertebrates, and EFH. Noise from pile driving would be temporary, occurring during installation of foundations for offshore structures. This noise would be produced intermittently during construction of each project for approximately 2 to 3 hours per foundation or for 4 to 6 hours per day for the installation of two foundations per day. One or more projects may install more than one foundation per day, either sequentially or simultaneously. Construction of offshore wind facilities in the geographic analysis area would likely occur over from 2022 to 2030 and beyond. Noise transmitted through water and/or the seabed can cause injury and/or mortality to finfish (and likely to invertebrates, though research is lacking) in a limited space around each pile and can cause short-term stress and behavioral changes to individuals over a greater space. The extent of these impacts depends on pile size, hammer energy, local acoustic conditions, and attenuation level. Behavioral impacts from pile-driving noise would likely extend radially less than 8.8 miles around each pile and the radius for injury, including potential mortality, is estimated to extend up to 515 feet, given the proposed noise attenuation mitigation measures for a 12-meter (39-foot) monopile (Pyć et al. 2018; COP Volume I, Section 3.3.1.4, Volume III, Section 6.6.2, and Volume III, Appendix M; Epsilon 2022a; BOEM 2021a). Based on these findings and the 1-nautical mile (1.9-kilometer, 1.15-mile) grid spacing of WTG and ESP foundations, the radius for potential injury or mortality would not overlap between any two foundations. The radius for behavioral impacts could overlap among two or more foundations if multiple piles are driven simultaneously by one project or multiple projects. With construction of all 2,955 foundations in Alternative A, the risk of injury, including potential mortality, is expected to occur over approximately 9,758 acres. 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. Popper et al. (2014) identifies 210 decibels referenced to 1 micropascal (dB re 1 µPa) squared second (μPa^2 s) sound exposure level (SEL), or 207 dB re 1 µPa peak sound pressure (Lpk) as the thresholds for mortality for eggs and larvae.

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), use sound to communicate (e.g., Atlantic cod), or spawn only once during their lifetime (e.g., longfin squid). 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, such as longfin squid or bluefish, would be more susceptible to disturbance from pile-driving noise. Therefore, pile-driving noise could cause reduced reproductive success in one or more spawning seasons, which could potentially result in long-term impacts on populations if one or more cohorts suffer suppressed recruitment. Recent studies on the behavioral impacts of pile-driving noise on black sea bass 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). Jones et al. (2021) determined that longfin squid feeding behaviors and ability to capture prey was affected by playbacks of pile-driving noise in a laboratory environment. Wilber et al. (2022) conducted a demersal trawl survey near the Block Island Wind Farm before, during, and after construction and reported the fall and spring biomass of longfin squid to vary synchronously between the wind farm area and regional surveys, suggesting the construction and operations of the wind farm had little to no impact on the local longfin squid populations. Under Alternative A, noise from pile driving could affect the same populations or individuals multiple times in a single year or in sequential years; it is currently unknown whether sequential or concurrent driving of multiple piles would have greater impacts.

Noise from G&G surveys of cable routes, unexploded ordinance (UXO), benthic resource monitoring, and other site characterization surveys for offshore wind facilities could also affect finfish, invertebrates, and EFH (Section 3.7, Marine Mammals, discusses UXO in greater detail). G&G noise would occur intermittently over an assumed construction period beginning in 2022 and extending through 2030 and beyond (Appendix E). 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 air gun 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 the 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. Seismic surveys are not expected in the geographic analysis area.

Noise from aircraft, trenching/cable burial, vessels, and WTG operations are expected to occur but would have little effect on finfish, invertebrates, and EFH. Offshore wind projects may use aircraft for crew transport during operations and/or construction; however, very little of the aircraft noise propagates through the water; 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 cable emplacement and 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 were loud enough to induce avoidance, but not physically harm, finfish and/or invertebrates (MMS 2009). Behavioral impacts would likely be temporary.

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). As measured at the Block Island Wind Farm, the low-frequency noise from WTG operation barely exceeds ambient levels at 164 feet from the WTG base (Thomsen et al. 2015; Kraus et al. 2016a). This type of noise would persist for the life of each offshore wind energy project.

Port utilization: Ports throughout the geographic analysis area would likely be upgraded in response to Alternative A (Table G.1-3), increasing the total amount of disturbed habitat. Ports are largely privately owned or managed businesses that are expected to compete against each other to host offshore wind activity. For example, at Vineyard Haven, which has undergone upgrades to host operations activities for offshore wind projects, barrier beach and intertidal habitat would be affected by past and ongoing 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 8 years and beyond, 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. Any port expansion and construction activities related to offshore wind projects would add to the total amount of disturbed habitat. Existing ports already affect 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 such as stormwater management and turbidity curtains to minimize impacts (Table G.1-3). Although the degree of impacts on EFH would likely be undetectable outside the immediate vicinity of affected ports, impacts on EFH for certain species and/or life stages may lead to temporary to permanent impacts on finfish and invertebrates beyond the vicinity of the ports.

Presence of structures: The presence of structures such as buoys, met towers, foundations, scour/cable protection, and submarine cable infrastructure could affect finfish, invertebrates, and EFH through entanglement and gear loss/damage, hydrodynamic disturbance, fish aggregation, habitat conversion, and migration disturbances. The potential locations of cable protection for future projects have not been fully determined at this time. Alternative A would include up to 2,955 foundations, 13,531 acres of foundation scour protection, and 1,705 acres of new hard protection atop cables (Appendix E). Projects may also install more buoys and met towers. structures would be added intermittently beginning in 2022 and continuing through 2030 and beyond, and they would remain until decommissioning of each facility is complete (30 years) Alternative A would substantially increase the number of structures, which are presently rare in the geographic analysis area.

The presence of structures may increase private and for-hire recreational fishing effort in areas where there was no effort previously (Section 3.9; Section 3.15, Recreation and Tourism) and increase the risk of gear loss/damage by entanglement with structures, potentially leading to injury or mortality of finfish and invertebrates. Commercial fisheries operating near structures may also experience gear loss, potentially increasing the impacts of ghost fishing and other disturbances on finfish, invertebrates, and EFH. Lost commercial fishing gear moved by currents could 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.

Human-made 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 modeling 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 (recommended eight to ten times the pile diameter). For the piles assumed to be used in Alternative A (i.e., 7-meter [23-foot] monopiles), disruption would occur up to 230 feet from and downstream of each pile. A shelf-scale model of a contiguous 297 WTG, 1.4 GW wind development area in sandy-bottom conditions in 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 (0.58 mile) downstream of a monopile foundation, and impacts varied based on array geometry (Cazenave et al. 2016). In general, modeling studies indicate that water flow typically returns to within 5 percent of background levels within a distance equivalent to 3.5 to 10 times an offshore structure's diameter (Chen et al. 2016; Miles et al. 2017). As a result, the disruption of mean flows is not likely to reach from one WTG or ESP 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 the RI/MA Lease Areas or other wind development areas in the geographic analysis area, due in part to water depths, which reduce the influence of tidal forcing on hydrodynamics. Water depths in wind development areas on the OCS typically range from 59 to 197 feet, whereas early offshore wind projects in the North Sea (which are the subject of many available studies) were installed in water depths between 9.8 and 65.6 feet. While the surface currents in the U.S. wind lease areas are comparable to those at European wind developments, the bottom currents are typically less, due to the greater water depth. Lower bottom currents reduce 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, impacts on finfish, invertebrates, and EFH from sediment resuspension near foundations are not anticipated to be measurable above existing 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 Section D-2 of Appendix D. The spatial scale of the potential impacts of many structures on oceanographic conditions is not well known but may be on the order of 0.5 nautical mile (0.58 mile) from each structure (Section D-2).

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 MAB 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. 2018a). During summer, local upwelling and 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 cold pool is a dynamic feature of the middle to outer portions of the continental shelf, but its nearshore boundary typically lies at depths from 66 to 131 feet (Brown et al. 2015; Chen et al. 2018a; Lentz 2017). Offshore wind lease areas are mostly sited within depths less than 197 feet. While offshore wind foundation structures would affect local mixing of cool bottom waters with warm surface waters, the extent to which these local impacts may cumulatively affect the cold pool is not well understood. Given the size of the cold pool—approximately 11,580 square miles (NMFS 2020a)—BOEM does not anticipate that future offshore wind structures, as described in Alternative A, would affect the cold pool, although they could affect local conditions. The presence of many offshore wind 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, possibly resulting in increased biomass of finfish and invertebrates. Changes in primary productivity might not translate into impacts 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 fishes that are at the southern/inshore extent of their temperature tolerance. The impacts on finfish and invertebrates from changes to local oceanographic and atmospheric conditions caused by the presence of offshore structures are expected to be localized and are 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 vertical relief in a mostly sandy seascape. Structure-oriented fishes such as black sea bass, striped bass, and Atlantic cod would be attracted to these locations. Abundance of certain fishes may increase near the structures (Claisse et al. 2014; Smith et al. 2016). These impacts would be local and endure as long as the structures remain. The impacts of fish aggregating around structures may be considered adverse or beneficial on finfish and invertebrate populations because the dynamics of predation and fishing would vary by location.

In addition to fish aggregation, the new structures may also provide new hard-structure habitat for structure-oriented and/or hard-bottom species, which may be beneficial (Daigle 2011). 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 (HDR 2019a; Kerckhof et al. 2019). Soft bottom is the dominant habitat type from Cape Hatteras to the Gulf of Maine (over 60 million acres), and species that rely on this habitat would not likely experience population-level impacts (Greene et al. 2010; Guida et al. 2017). 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, black sea bass, striped bass, etc.) would gain habitat, while obligate soft-bottom species (e.g., summer flounder, Atlantic surf clam, and longfin squid) would see habitat locally reduced. The attraction of structure-oriented predators (e.g., black sea bass) may affect 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 (*Mytilus edulis*) and anemones (Kerckhof et al. 2019). Invertebrate and fish assemblages may develop around these reef-like elements within the first few years after construction (English et al. 2017). Although some studies have noted increased biomass and 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 fishes 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 2019a). The potential impacts of offshore wind facilities on offshore ecosystem functioning have 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 can increase bivalve biomass and shift local food webs toward detritivores.[13] They also indicated higher biomass for benthic fish and invertebrates and possibly for pelagic fish, marine mammals, and birds. Overall, omnivorous behavior,[14] energy recycling, and general ecosystem activity were all predicted to increase after offshore wind facility construction

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[13] A detritivore is an organism that obtains its nutrition by feeding on detritus.

[14] An omnivorous animal is one that has the ability to eat and survive on both plant and animal matter.

(Pezy et al. 2018; Raoux et al. 2017; Wang et al. 2019). These changes may not necessarily happen evenly 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 (Stanley 1994) to 1,968.5 feet (Kang et al. 2011) from a structure, and Rosemond et al. (2018) have suggested assuming a distance of 98 to 197 feet 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, black sea bass, and lobster). There is little empirical information available to indicate what effect, if any, structures might have on movement patterns and migrations (Sparling et al. 2020). 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 larger driver of habitat occupation and migration than structure presence (Moser and Shepherd 2009; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded.

Long-term monitoring studies from Belgium and Denmark broadly show that long-term operational impacts of offshore wind structures on the marine benthic environment (e.g., increased animal abundances, compositional shifts) are evident close to foundations and scour protection (Lefaible et al. 2019), and no impacts have been evident at the scale of an entire facility (Bergström 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 construction of the wind facilities (Degraer et al. 2019). Epibenthic density and biomass showed a similar trend with an increase in the first 2 years after construction. These higher values, however, leveled off 3 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) has not changed substantially 5 to 6 years after construction and that species assemblages within the offshore wind energy facilities 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, some species of fish seemed to respond positively to offshore wind structures, but these potentially beneficial impacts cannot be distinguished 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, 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.

While primarily an ongoing activity, regulated fishing effort affects 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 and can also influence bycatch of non-regulated species. Future offshore wind development other than the proposed Project could affect finfish, invertebrates, and EFH through this IPF by influencing the management measures chosen to support fisheries management goals, which may alter the nature, distribution, and intensity of fishing-related impacts on finfish, invertebrates, and EFH (Section 3.9).

Traffic: Construction, operations, and decommissioning of ongoing and planned activities would generate new 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 3 years per project) would generate an average of 22 and a maximum of 56 vessels operating in the geographic analysis area for navigation and vessel traffic at any given time. As shown in Table E-1 in Appendix E, construction-related vessel traffic in the geographic analysis area would be at its peak in 2026 (Section 3.13, Navigation and Vessel Traffic) when as many as 16 offshore wind projects (other than the proposed Project) could be under construction simultaneously. This vessel activity would be distributed across the entire geographic analysis area, leading to marginal increases in regional vessel traffic above historical baseline averages, which is not expected to result in a significant increase in impacts related to vessel traffic.

Endangered Species Act-Listed Species

The endangered Atlantic sturgeon, giant manta ray, and oceanic whitetip shark are the only finfish or invertebrate listed under the ESA that may be affected by the proposed Project. Subadult and adult Atlantic sturgeon occur in marine waters year-round. Giant manta ray and oceanic whitetip sharks are found within the New England and MAB mainly from July through September when waters reach 19 to 22 Celsius [°C]). Ongoing activities, future non-wind activities, and future offshore wind activities other than the proposed Project may also affect the Atlantic sturgeon, giant manta ray, and oceanic whitetip sharks. For the Atlantic sturgeon, all five DPSs could be affected by the proposed offshore wind projects, the geographic analysis area for this species is its entire range shown on Figure 3.6-1. All of the IPFs and impacts on finfish and EFH discussed above could also apply to the Atlantic sturgeon, giant manta ray, and oceanic whitetip sharks (BOEM 2022d). The most prominent IPF for each of these species is likely to be noise from pile driving; however, most pile driving is anticipated to occur in the summer, when mature Atlantic sturgeon are more likely to reside in rivers and nearshore waters, thus reducing their risk of exposure to pile-driving noise (Ingram et al. 2019). Pile-driving noise for the giant manta ray and oceanic whitetip shark could result in **minor** impacts. These two listed species can be present within the deeper water areas of the SWDA and OCEE within the summer months. This timeframe would coincide with construction and pile-driving activities. Both the giant manta ray and oceanic whitetip shark have no swim bladder (non-physoclistic) and are less sensitive to sound impacts. The pile-driving activities related to the proposed offshore wind projects could displace the giant manta ray and oceanic whitetip shark, disturbing their behavior and potential feeding opportunities. These impacts would likely be short term and localized to the construction site.

Conclusions

Impacts of Alternative A. Under Alternative A, finfish, invertebrates, and EFH would continue to follow current regional trends and respond to current and future environmental and societal activities. While the proposed Project would not be built under Alternative A, ongoing activities would 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, cable emplacement and maintenance, the presence of structures, and climate change. The impacts of ongoing activities, especially fishing, dredging, and climate change, would be **moderate**.

Cumulative Impacts of Alternative A. In addition to ongoing activities, planned activities other than offshore wind may also contribute to impacts on finfish, invertebrates, and EFH. Planned activities other than offshore wind include increased vessel traffic; new submarine cables and pipelines; increasing onshore construction; marine surveys; marine minerals extraction; port expansion; channel-deepening activities; and the installation of new towers, buoys, and piers. The impacts of planned activities other than offshore wind would be **minor**. The combination of ongoing and planned activities other than offshore wind would result in **moderate** impacts on finfish, invertebrates, and EFH, primarily through ongoing fishing activities.

Considering all the IPFs together, the overall impacts associated with future offshore wind activities in the geographic analysis area combined with ongoing and planned activities would result in **moderate** impacts and could potentially include **moderate** beneficial impacts. Future offshore wind activities are expected to contribute considerably to several 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 pile-driving noise. However, ongoing impacts resulting from fishing pressure, especially via dredging and bottom-trawling methods, would continue to be one of the most impactful IPFs in the geographic analysis area for finfish, invertebrates, and EFH.

3.6.2.2 Relevant Design Parameters and Potential Variances in Impacts

The following proposed Project design parameters (Appendix C, Project Design Envelope and Maximum-Case Scenario) would influence the magnitude of impacts on finfish, invertebrates, and EFH:

- The total amount of long-term habitat alteration from scour protection for the foundations, inter-array cables, and export cables;
- The total amount of habitat temporarily altered by installation of the export cable in the OECC and inter-array and inter-link cables in the SWDA;
- The number, size, and type of foundations used for the WTGs and ESPs;
- The methods used for cable laying, as well as the types of vessels used;
- The amount of dredging associated with cable laying, if any, and its location; and
- The time of year when construction activities occur in relation to migrations and spawning for fish and invertebrate species.

The potential impacts would have a greater magnitude if construction activities coincided with sensitive life stages for finfish and invertebrate organisms.

3.6.2.3 Impacts of Alternative B – Proposed Action on Finfish, Invertebrates, and Essential Fish Habitat

This section identifies the potential impacts of Alternative B on finfish, invertebrates, and EFH. Except where otherwise stated, the impacts of Phase 1 decommissioning would be similar to those for Phase 1 construction for all of the IPFs described below.

Impacts of Phase 1

Phase 1 would affect finfish, invertebrates, and EFH through the following primary IPFs during construction, operations, and decommissioning.

Accidental releases: In addition to accidental releases of other materials, accidental releases of invasive species from vessels associated with Phase 1 would have a low risk of resulting in widespread and permanent impacts, as discussed in Section 3.6.2.1. The increase in risk of accidental releases of invasive species attributable to Phase 1 would be **negligible**. Section 2.3 describes the non-routine activities associated with Phase 1. These activities, if they were to occur, would generally require temporary activity to address emergency conditions, fuel spills, accidental releases of waste material, collisions, and allisions. Non-routine events such as oil or chemical spills can have adverse or lethal impacts on marine life. Spills are expected to occur at the surface, and impacts on the water column would be mostly limited to the surface-mixed layer, or approximately 33 feet. Oils in particular tend to stay at the surface, and other chemicals are predicted to dilute to non-toxic levels before they would reach most finfish, invertebrates, and EFH. Small spills would, therefore, have a **negligible** impact, while larger spills, which are unlikely, could have a **moderate** impact on species due to impacts on water quality (Section G.2.2).

The greatest source of risk for accidental releases during operations results from vessel traffic related to maintenance and survey monitoring activities. Phase 1 operations would generate approximately 250 vessel round trips per year (Section 3.13). If an accidental release were to occur, the impacts would be localized and temporary due to the likely limited extent and duration of a release and result in **negligible** to **minor** impacts. Mitigation measure such as OSRPs will be in place for immediate response to vessel release resulting in a localized and temporary impact due to the likely limited extent and duration of a release.

Anchoring and gear utilization: Anchoring used in Phase 1 would leave marks on the seabed, increase turbidity levels, and have the potential for physical contact to cause mortality of benthic and demersal species. Impacts on finfish, invertebrates, and EFH from anchoring 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 would occur during construction in the SWDA and OECC, but would be limited, with a total expected area of vessel and buoy disturbance totaling 421 acres (COP Appendix III-T, Table 2; Epsilon 2022a). All impacts would be localized, turbidity would be temporary, and most impacts from physical contact would be recovered in the short term. Degradation of sensitive EFH, if it occurs, could be long term to permanent. The anticipated impacts on finfish, invertebrates, and EFH from anchoring under Phase 1 would be **minor**. Monitoring surveys would result in similar seafloor impacts as those described for anchoring. However, given the short-term, low-intensity, and localized nature of the impacts of gear utilization, impacts would be **negligible**.

Cable emplacement and maintenance: Cable emplacement impacts would include temporary displacement of mobile benthic species inhabiting the OECC route (i.e., winter flounder, American lobster, monkfish). Impacts on sessile species and life stages (i.e., demersal eggs, squid egg mops, Atlantic surf clam) would include a reduction in fitness or mortality. Impacts related to habitat disturbance in the immediate area of emplacement activities would be unavoidable and temporary to permanent, depending on the type of habitat affected. Localized loss of demersal eggs could lead to reduced fish recruitment; however, this impact would be limited, and BOEM does not anticipate impacts at a population level. For the Cape Wind Energy Project, seabed scars associated with jet plow cable installation were expected to recover in 1 to 38 days (Applied Science Associates 2005), allowing for rapid recolonization from the surrounding area (MMS 2009). Phase 1 would not affect beds or loose aggregations of eelgrass EFH HAPC for juvenile and adult summer flounder because Phase 1 would avoid eelgrass aggregations; however, Phase 1 could affect HAPC for juvenile Atlantic cod. All the hard-bottom habitat within the OECC would be considered HAPC for juvenile Atlantic cod, as would some other habitat types not mapped. Some HAPC for juvenile Atlantic cod in the OECC would be altered by cable installation. The total amount of juvenile Atlantic cod HAPC that could be disturbed by the proposed Project is not known but would not exceed (and would likely be only a fraction of) the total area of disturbance within the OECC, namely 263 acres (COP Appendix III-T, Table 5; Epsilon 2022a).

To avoid impacts on the high concentrations of fishing activities and natural resource events (e.g., spawning of squid and other species) in springtime within Nantucket Sound, the applicant would avoid cable installation in Nantucket Sound during springtime. Overall, there would be **moderate** impacts from the temporary habitat disturbance on finfish, invertebrates, and EFH.

BOEM could require the applicant, as a condition of COP approval, to develop a fisheries monitoring plan for construction, operations, and decommissioning, similar to (or as an extension of) the fisheries monitoring plan implemented for Vineyard Wind 1 (Cadrin et al. 2019). Under such a plan, fisheries monitoring would be conducted before, during, and after construction in the proposed Project area and control areas to support a "beyond before after control impact" analysis (e.g., sampling at multiple control sites at multiple periods before and after impact). Sampling would be conducted four times: pre-construction (to assess existing conditions); during construction; and at two different intervals during operations (i.e., 1 year after construction and in some later year post-construction). Each of these four assessment periods would capture all four seasons of the year. Fisheries survey methodologies include trawl survey for finfish and squid, ventless trap survey, plankton survey, and optical survey (drop-camera) of benthic invertebrates and habitats. All fisheries monitoring plan surveys would be consulted and coordinated among BOEM, NMFS, and the applicant to ensure that impacts from post-construction monitoring activities are mitigated to the level of least practicable adverse impact.

The applicant would implement a benthic monitoring plan (COP Appendix III-U; Epsilon 2022a) to document the disturbance to and recovery of marine benthic habitat and communities as a result of construction of different proposed Project components. Post-construction monitoring could reduce later impacts on finfish and invertebrate resources in the region. Information gained via post-construction monitoring by the applicant could be used to inform decommissioning procedures and/or could be used by others planning similar projects in the future to assist in reducing potential impacts.

The COP for the proposed Project models the potential turbidity resulting from construction activities (Appendix III-A; Epsilon 2022a). Impacts associated with turbidity are likely to affect benthic species more than pelagic species because the increased turbidity occurs primarily in the bottom 19.7 feet of the water column (COP Appendix III-A, Section 4.3.4; Epsilon 2022a). Turbidity would likely displace mobile juvenile and adult species (i.e., striped bass, alewife [*Alosa pseudoharengus*]), which could expose them to increased predation, temporarily reduce prey availability, and result in higher energetic costs. For sessile organisms unable to escape the suspended sediment plumes, the impacts could range from reduced fitness to mortality (Wilber and Clarke 2001; Berry et al. 2011). Sub-lethal impacts for mollusk eggs occur with an exposure of 200 milligrams per liter for 12 hours; for other life stages, the minimum threshold for sub-lethal impacts would be 100 milligrams per liter for 24 hours (COP Volume III, Section 6.5.2.1.2; Epsilon 2022a). Sessile organisms in the SWDA might be affected by turbidity multiple times during construction, potentially compounding impacts and possibly increasing mortality. Based on the modeled concentration of total suspended solids and the estimated time it would remain suspended, there would be **minor** temporary impacts because any reductions in abundance or fitness of organisms would likely recover naturally. The EFH assessment (BOEM 2022c) and other BOEM studies (2018d, 2019e, 2020) provide additional information on potential impacts on fish, invertebrates, and EFH for Phase 1 activities, based on studies conducted for Vineyard Wind 1.

Water withdrawals are necessary for jet plow cable installation. The COP describes water withdrawal and estimates the quantities withdrawn (Volume III, Section 6.5.2.1.4; Epsilon 2022a). Due to the surface-oriented intake for the jet plow, water withdrawal could entrain eggs and larvae of pelagic finfish and invertebrates, resulting in 100 percent mortality (MMS 2009). However, the rate of egg and larval survival to adulthood for many species of marine finfish is very low (MMS 2009), and mortality associated with entrainment would be insignificant at the population level. Jet plowing would impact species with pelagic eggs or larvae, including numerous flatfish species such as windowpane flounder, winter flounder, witch flounder (*Glyptocephalus cynoglossus*), yellowtail flounder, and summer flounder; important commercial groundfish species such as Atlantic cod, haddock, and pollock; and other recreationally and commercially important species such as monkfish, Atlantic herring, Atlantic mackerel, silver hake, and butterfish. Species with demersal eggs such as longfin squid, Atlantic sea scallops, Atlantic wolffish, ocean pout (*Zoarces americanus*), and winter flounder, which adhere to bottom substrate, would not be affected by the water withdrawal aspect of jet plowing. Most jet plowing would take place during summer and could impact eggs and larvae present at that time (BOEM 2022c). Based on the limited time of jetting and the overall habitat available for pelagic eggs and larvae in comparison to the volume of water withdrawn, there would be temporary and **minor** impacts, with affected populations completely recovering after jet plowing activities. The EFH assessment (BOEM 2022c) and the Vineyard Wind 1 BA and Biological Opinion (BO) provide additional information on potential impacts on fish, invertebrates, and EFH for Phase 1 activities (BOEM 2019d, 2019e; NMFS 2020b).

There would be **negligible** impacts on finfish, invertebrates, and EFH at the landfall site because the HDD would traverse under the seafloor and beach at either Covell's Beach or Craigville Beach. Due to summer construction restrictions on Cape Cod (unless authorized by the Town of Barnstable), the applicant would not make the landfall transition from June through September.

BOEM could require the applicant, as a condition of COP approval, to restrict its dredging and cable installation methods and timing (Appendix D), potentially in combination with additional habitat characterization. This would reduce the degree of new cable emplacement impacts compared to the maximum-case scenario, although the impacts described above would still occur; therefore, the level of impacts would remain the same.

Dredging for cable installation in the OECC would cause localized and short-term impacts (habitat alteration, change in complexity) on finfish, invertebrates, and EFH through seabed profile alterations, as well as sediment deposition. The dredging potentially involved in Phase 1 could affect up to 52 acres, resulting in temporary seabed profile alterations. These bathymetric changes would create narrow troughs or flats in fields of sand waves, changing the character of the seafloor as finfish and invertebrate habitat. The corresponding impacts on finfish, invertebrates, and EFH would be **minor** and would dissipate over time as mobile sand waves fill in the altered seabed profile.

In areas where cable is installed via a jet or mechanical plow, impacts would be localized and temporary and would recover completely without mitigation. In areas where seabed conditions might not allow for cable burial to the desired depth, other methods of cable protection would be employed, such as rock armoring, gabion rock bags, or concrete mattresses, which would permanently alter the seabed profile. Overall, impacts on finfish, invertebrates, and EFH from seabed profile alterations under Phase 1 would be **minor**.

Dredged material disposal during construction would cause temporary, localized turbidity increases and long-term sedimentation or burial at the immediate disposal site. Sediment deposition and burial could also occur as a result of cable installation methods. Phase 1 construction could affect finfish, invertebrates, and EFH by covering habitat, smothering sessile organisms or life stages, and habitat avoidance or abandonment by mobile species. Mobile species of finfish and invertebrates (e.g., flatfish) would likely avoid or abandon deposition areas. Slow-moving but mobile species (e.g., Jonah crabs, Atlantic horseshoe crabs, whelks, Atlantic sea scallops) may not be able to escape the affected area but would likely be able to uncover themselves during and after sedimentation. Sessile species are often capable of handling some degree of sediment deposition because turbidity and sedimentation occur naturally in soft-bottom habitats (e.g., during storm events; Wilber et al. 2005). Sediment deposition could bury demersal eggs and newly settled bivalve spat (i.e., American oyster [*Crassostrea virginica*] spat, longfin squid egg mops, Atlantic wolffish eggs, whelk egg cases and hatchlings), leading to sub-lethal impacts or mortality. Wilber and Clarke (2001) found reduced feeding and respiratory rates in oysters when exposed to deposition from dredging. Mortality can occur to sessile shellfish in sedimentation levels greater than 0.8 inch (Wilber and Clarke 2001; COP Volume III, Section 6.5.2.1.3; Epsilon 2022a). Benthic eggs and larvae (e.g., whelks, winter flounder, longfin squid egg mops) are more susceptible to increased mortality rates in depositions over 0.04 inch (Wilber and Clarke 2001; Berry et al. 2011). Sediment thickness and deposition modeling for Phase 1 indicates that only 2.5 acres would experience of deposition greater than 0.2 inch, with potential impacts on demersal eggs and species of similar sensitivity within the SWDA (COP Volume III, Section 6.5.2.1.3; Epsilon 2022a). Shellfish and organisms of similar sensitivity are not expected to be affected by sediment deposition from cable installation in the SWDA. Sediment deposition covering hard-bottom habitat along the OECC could temporarily impact juvenile Atlantic cod HAPC (BOEM 2019e) and impact the settlement of bivalve larvae (Wilber and Clarke 2001). Based on the limited distribution of sediment depositions exceeding 0.04 inch along the OECC and the overall minimal amount of soft-bottom habitat affected by Phase 1, there would be temporary and **minor** impacts, with affected populations completely recovering following construction activities (BOEM 2022c, BOEM 2019e; NMFS 2020a).

As described above, the individual activities associated with Phase 1 cable emplacement and maintenance during construction (i.e., habitat disturbance, sediment deposition, dredging, and seabed profile alteration) would have **negligible** to **minor** impacts on finfish, invertebrates, and EFH. Impacts would be measurable, but the affected species and habitats would return to normal (pre-construction) without mitigation and would, thus, have an overall impact rating of **minor**.

Section 2.3 describes the non-routine activities associated with Phase 1; similar non-routine activities could occur for other future offshore wind activities. These activities, if they were to occur, would generally require temporary activity to address emergency conditions. The offshore export cables and inter-array cables would be monitored through distributed temperature sensing equipment. The distributed temperature sensing system would be able to provide real-time monitoring of temperature along the OECC, alerting the applicant should the temperature change, which could be the result of scouring of material and cable exposure. If cable repairs are needed, support vessels such as a jack-up vessel may be used. As such, only cable repairs (if required) would temporarily impact benthic finfish life stages and demersal and sessile invertebrates and only in a localized area immediately adjacent to the repair. Impacts from occasional non-routine activities to repair segments of cables would be similar to those temporary habitat disturbances involved in installation. Generally, the disturbance to finfish, invertebrates, and EFH would be temporary and localized, with an abundance of similar foraging habitat and prey available in adjacent areas. Assuming repairs would be infrequent and affecting only small sections of the cables, impacts on finfish, invertebrates, and EFH from cable repairs would be unmeasurable and, therefore, **negligible**.

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 fishes in the northeast United States, with several species shifting their centers of biomass either northward or to deeper waters (Gaichas et al. 2015; Hare et al. 2016). Several sub-IPFs related to climate change, including ocean acidification, warming/sea level rise, altered habitat or ecology, altered migration patterns, and increased disease frequency, have the potential to result in long-term, potentially high-consequence risks to finfish, invertebrates, and EFH. Ocean acidification affects the settlement and survival of shellfish (PMEL 2020) and would contribute to the reduced growth or decline of invertebrates that have calcareous shells. These impacts could lead to changes in prey abundance and distribution, changes in migratory patterns, and timing of migrations for finfish and invertebrates. The impacts through this IPF from Phase 1 would be the same as those under Alternative A. The intensity of impacts resulting from climate change are uncertain but are anticipated to qualify as **minor** to **moderate**.

EMF: Biologically significant impacts on finfish, invertebrates, and EFH have not been documented for EMF from AC cables (CSA Ocean Sciences, Inc. and Exponent 2019; Thomsen et al. 2015); however, many marine and diadromous species can sense electric and/or magnetic fields, and EMF from submarine cables may affect their ability to navigate and detect predators/prey or could cause physiological and developmental impacts (Gill and Desender 2020; Taormina et al. 2018). In the United States, behavioral impacts have been documented for benthic species (skate and lobster) near operating direct current cables (Hutchison et al. 2018, 2020). Buried submarine cables reduce, but do not entirely eliminate, EMF (Taormina et al. 2018). To minimize EMF generated by cables, all cabling would be contained in grounded metallic shielding to prevent detectable electric fields. The applicant would also bury cables to a target burial depth of 5 to 8 feet below the surface or use cable protection, which would diminish the impact of EMF so that it would likely impact only demersal species. The closer the cable is to the sediment-water interface, the stronger the exposure to magnetic fields.

Demersal species living on or near the seafloor, where the magnitude of cable EMF would be highest, are more likely to detect EMF than pelagic species, which live higher in the water column. Cable networks like the inter-array cable in the SWDA could potentially have collective impacts on finfish and invertebrates that encounter multiple cables on a regular basis as part of their typical movement patterns. However, the minimal distance of EMF radiating from each cable in the SWDA (approximately 65.6 feet; Normandeau et al. 2011) and the spacing of the cables (approximately 1 mile apart) should create a large enough gap between cables to reduce any collective impact from such frequent and repeated encounters.

Atlantic sturgeon have both electro and magneto sensitivity that can affect feeding, predator detection, and navigation (BOEM 2012a), although research suggests marine species may be less likely to detect EMF from AC cables (BOEM 2012a). Although some species-specific avoidance behavior has been observed, no evidence of population-scale impacts or physiological impacts have been reported, and studies of EMF impacts on invertebrates are scarce (Taormina et al. 2018; Gill and Desender 2020). American lobster held in cages displayed behavioral differences when exposed to EMF, but the research did not indicate a barrier to movement (Hutchison et al. 2018, 2020). The same studies found that little skate, an electrosensitive elasmobranch, was even more sensitive to the EMF, which led to movement patterns that could be interpreted as increased foraging behavior; again, the EMF did not constitute a barrier to movement. Although a study by Scott et al. (2018) found that the edible crab (*Cancer pagurus*) is attracted to EMF, the impacts were seen only at field strengths greater than 150 times the field strength expected directly over Phase 1’s cables (Epsilon 2018). Currently, there is no evidence that EMF would result in population-scale impacts on fishes or invertebrates (Taormina et al. 2018; Hutchison et al. 2018, 2020; Gill and Desender 2020). A field survey found that an AC cable design comparable to that proposed by the applicant produced a much weaker magnetic field than expected (Hutchison et al. 2018); field strength was insignificant approximately 33 feet from the cable. Therefore, impacts on pelagic species would likely be **negligible**. By burying cables and containing them in grounded metallic shielding (Normandeau et al. 2011), the impacts of EMF should be **minor** on finfish, invertebrates, and EFH. See the EFH assessment for additional discussion of EMF impacts on other fishes or invertebrates with EFH in the SWDA and OECC (BOEM 2022c). NMFS’s BO for Vineyard Wind 1 concluded that EMF from the proposed Project would be extremely unlikely to affect the Atlantic sturgeon (NMFS 2020a).

As discussed in Section 3.6.2.1, EMF production during the operations of power transmission cables can be detected by some finfish and invertebrate species but does not appear to present a barrier to movement. EMF impacts would be minimized by burying cables to the target depth of 5 to 8 feet below the seafloor. The impacts on finfish, invertebrates, and EFH from EMF would be **negligible** to **minor** during operations.

Lighting: Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light can also disrupt natural cycles such as spawning. Phase 1 would allow nighttime work only on an as-needed basis and would not allow pile driving to begin at night. As a result, light from Phase 1 vessels is not anticipated to result in biologically significant impacts on finfish, invertebrates, and EFH. Up to 63 WTGs and ESPs would have aviation hazard navigation lights, but no downward-focused lighting. Each WTG would be lit in accordance with USCG, FAA, and BOEM requirements, and only a small fraction of the emitted light would enter the water (BOEM 2021a; COP Volume III, Section 2.2.1; Epsilon 2022a). Therefore, lighting from Phase 1 would be minimal and lead to a **negligible** impact, if any, on finfish, invertebrates, and EFH.

Vessel generated lighting would be greatly reduced during the operational stage of the proposed Project. Service vessels and tenders would mainly be supporting operations during daylight hours greatly reducing the need for artificial sources of light within the SWDA. Lighting impacts would only slightly increase, but not significantly, during decommissioning operations if WTG were to be removed. Lighting during Phase 1 operations and decommissioning would have a **negligible** impact on finfish and invertebrates

Noise: Phase 1 construction activities would result in noise from vessel activity, G&G surveys, pile driving for WTG and ESP installations, and cable burial or trenching. These activities would result in short-term increases in underwater noise from Phase 1 construction. Underwater sounds would include repetitive, high-intensity (impulsive) sounds produced by pile driving, and continuous (non-impulsive), lower-frequency sounds produced by vessel propulsion and cable jetting installation methods. The intensity of this sound would vary, with some sounds being louder than ambient noise (pile-driving hammer strikes). Ambient noise within the SWDA averaged between 76.4 and 78.3 dB re 1 µPa (COP Appendix II-A, Attachment E; Epsilon 2022a). Ambient noise can influence how fish detect other sounds because fish have localized noise filters that separate background noise and other sounds simultaneously (Popper and Fay 1993).

The intensity and magnitude of impact pile driving could result in injury and/or mortality to finfish and invertebrates in a localized area around each pile and 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. Popper et al. (2014) identifies 210 dB re 1 µPa^2 s SEL, or 207 dB re 1 µPa Lpk as the thresholds for mortality for eggs and larvae. Potentially injurious noise could also be considered as rendering EFH temporarily unavailable or unsuitable during pile-driving activities. The extent of pile-driving acoustic impacts depends on pile size, hammer energy, and local acoustic conditions. Noise from pile driving during Phase 1 construction would occur during installation of monopile and jacket pilings for WTGs and ESPs. Each of the piles would require an estimated 2 to 3 hours per pile or 4 to 6 hours per day over the 2-year period, increasing the risk of injury to finfish and invertebrates in a limited radius around each pile and short-term stress and behavioral changes to individuals over a broader area.

Potential impacts on finfish and invertebrates, as described in Section 3.6.2.1, could include mortality, injury, and behavioral disturbances. Noise impacts would predominantly affect fishes that have swim bladders connected to the ear (otoliths) and some invertebrates such as squid that have lateral lines and statocysts that detect particle motion (i.e., water movement) (Mooney et al. 2016; Solé et al. 2018). Noise impacts could also affect fish and invertebrates that spawn during the summer months when-pile driving activities occur. This is of particular concern for species that also spawn once in a lifetime, such as longfin squid, which could result in a reduction of reproductive success over one or more spawning seasons. While limited available research suggests longfin squid are susceptible to behavioral responses from pile driving (Jones et al. 2020; Jones et al. 2021), fisheries data collected before, during, and after a recent wind energy development showed no significant impact on longfin squid populations (Wilber et al. 2022). To assess the potential impacts of anthropogenic sound on fish, Popper et al. (2014) classified fishes into three groups: fishes with swim bladders whose hearing does not involve the swim bladder or other gas volumes (e.g., tuna or Atlantic salmon); fishes whose hearing involves a swim bladder or other gas volume (e.g., Atlantic cod or herring); and fishes without a swim bladder (e.g., sharks) that can sink and settle on the substrate when inactive (Carroll et al. 2017; Popper et al. 2014). The most sensitive species are those with swim bladders connected or close to the inner ear. These species can experience both recoverable and mortal injuries at lower sound levels than other species (Popper et al. 2014; Thomsen et al. 2006).

Acoustic modeling for proposed Project pile driving estimated the radial distance to sound thresholds from the center of 12-meter (39.4-foot) and 13-meter (42.7-foot) monopiles and the center of a jacket foundation consisting of four, 4-meter (13.1-foot) piles (COP Appendix III-M; Epsilon 2022a). Phase 1 would include 4-meter (13-foot) monopiles to support ESPs and 12-meter (39-foot) monopiles to support WTGs. The acoustic model simulations used a range of pile-driving hammer energies (5,000 kilojoule [kJ] and 6,000 kJ); broadband noise attenuation levels of 0, 10, and 12 dB; and various sound thresholds for several types of impacts (i.e., potentially mortal injury, recoverable injury, temporary threshold shift [TTS], masking, and behavioral impacts) for fishes with different hearing structures and life cycle phases (Table 3.6-2 through Table 3.6-6).

Table 3.6-2: Impulsive Pile-Driving Acoustic Metrics and Thresholds for Finfish

Faunal Group	Injury (PTS)		Behavior
	Lpk	SEL_{24h}	SPL
Fish equal to or greater than 2 grams[a,b]	206	187	150
Fish less than 2 grams[a,b]	206	183	150
Fish without swim bladder[c]	213	216	NA
Fish with swim bladder not involved in hearing[c]	207	203	NA
Fish with swim bladder involved in hearing[c]	207	203	NA

Source: COP Appendix III-M, Table 9; Epsilon 2022a

dB re 1 µPa = decibels referenced to 1 micropascal; Lpk = peak sound pressure (dB re 1 µPa); NA = not available; PTS = permanent threshold shift; SEL_{24h} = sound exposure level over 24 hours (dB re 1 µPa^2 s[squared second]); SPL = root mean square sound pressure (dB re 1 µPa); TTS = temporary threshold shift

[a] This is NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (2008).

[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007)

[c] Popper et al. (2014)

[d] Finneran et al. (2017)

[e] McCauley et al. (2000)

Table 3.6-3: Radial Distances (Feet) to Fish Auditory Injury Thresholds, Four 4-Meter Jacket Foundation Piles[a]

Faunal Group	Metric	Threshold	Attenuation Level (dB)		
			0	10	12
Fish without swim bladder	Lpk	213	430	26	16
	SEL_{24h}	216	3,990	659	472
Fish with swim bladder not involved in hearing	Lpk	207	1,345	328	108
	SEL_{24h}	203	22,382	6,076	4,826
Fish with swim bladder involved in hearing	Lpk	207	1,345	328	108
	SEL_{24h}	203	22,382	6,076	4,826
Fish greater than or equal to 2 grams	Lpk	206	1,444	354	285
	SEL_{24h}	187	86,362	39,364	32,949
Fish less than 2 grams	Lpk	206	1,444	354	285
	SEL_{24h}	183	113,471	54,915	46,867

Source: COP Appendix III-M, Table 18; Epsilon 2022a

dB = decibel; dB re 1 µPa = decibels referenced to 1 micropascal; Lpk = peak sound pressure (dB re 1 µPa); SEL_{24h} = sound exposure level over 24 hours (dB re 1 µPa^2 s [squared second])

[a] This assumes 6,000 kJ pile-driving hammer energy.

Table 3.6-4: Radial Distances (Feet) to Fish Auditory Injury, 12-Meter Monopile[a]

Faunal Group	Metric	Threshold	Attenuation Level (dB)		
			0	10	12
Fish without swim bladder	Lpk	213	689	154	118
	SEL_{24h}	216	2,953	420	292
Fish with swim bladder not involved in hearing	Lpk	207	1,772	344	259
	SEL_{24h}	203	15,830	4,478	3,222
Fish with swim bladder involved in hearing	Lpk	207	1,772	344	259
	SEL_{24h}	203	15,830	4,478	3,222
Fish greater than or equal to 2 grams	Lpk	206	1,903	515	308
	SEL_{24h}	187	62,825	28,727	23,760

Faunal Group	Metric	Threshold	Attenuation Level (dB) 0	10	12
Fish less than 2 grams	Lpk	206	1,903	515	308
	SEL_{24h}	183	80,784	40,299	34,104

Source: COP Appendix III-M, Table 16; Epsilon 2022a

dB = decibel; dB re 1 µPa = decibels referenced to 1 micropascal; Lpk = peak sound pressure (dB re 1 µPa); SEL_{24h} = sound exposure level over 24 hours (dB re 1 µPa^2 s [squared second])
[a] This assumes 6,000 kJ pile-driving hammer energy, $R_{95\%}$ values.

Table 3.6-5: Radial Distances (Feet) to Fish Auditory Injury, 13-Meter Monopile[a]

Faunal Group	Metric	Threshold	Attenuation Level (dB) 0	10	12
Fish without swim bladder	Lpk	213	853	171	89
	SEL_{24h}	216	1,837	354	262
Fish with swim bladder not involved in hearing	Lpk	207	1,903	374	305
	SEL_{24h}	203	13,773	3,383	2,267
Fish with swim bladder involved in hearing	Lpk	207	1,903	374	305
	SEL_{24h}	203	13,773	3,383	2,267
Fish greater than or equal to 2 grams	Lpk	206	2,034	417	341
	SEL_{24h}	187	63,340	26,683	21,811
Fish less than 2 grams	Lpk	206	2,034	417	341
	SEL_{24h}	183	85,633	38,980	32,201

Source: COP Appendix III-M, Table 17; Epsilon 2022a

dB = decibel; dB re 1 µPa = decibels referenced to 1 micropascal; Lpk = peak sound pressure (dB re 1 µPa); SEL_{24h} = sound exposure level over 24 hours (dB re 1 µPa^2 s [squared second])
[a] This assumes 6,000 kJ pile-driving hammer energy, $R_{95\%}$ values.

Table 3.6-6: Radial Distances (Miles) to Fish Behavioral Thresholds[a]

Pile Type	Attenuation Level (dB) 0	10	12
Four 4-meter jacket foundation piles at 3,500 kJ hammer energy	12.3	5.2	4.3
12-meter monopile foundation at 6,000 kJ hammer energy	16.8	8.8	7.5
13-meter monopile foundation at 5,000 kJ hammer energy	17.3	8.0	6.7

Source: COP Appendix III-M, Tables 19-22; Epsilon 2022a

dB = decibel; dB re 1 µPa = decibels referenced to 1 micropascal; kJ = kilojoule
[a] Based on GARFO 2020 criteria, this uses unweighted sound pressure level of 150 dB re 1 µPa.

The standard acoustic behavioral threshold is 150 dB re 1 µPa for all fishes (Andersson et al. 2007; Mueller-Blenke et al. 2010; Purser and Radford 2011; Wysocki et al. 2007). As shown in Table 3.6-6, radial distances to potential behavioral disturbance for fish are between 12.3 and 17.3 miles without attenuation. To mitigate these impacts, the applicant proposed to use underwater noise abatement systems (e.g., encapsulated bubble sleeve and/or bubble curtains). These attenuation measures have been shown to be successful in reducing sound impacts with an attenuation of 10 to15 dB in good environmental conditions (Buehler et al. 2015). Attenuation of 12 dB would reduce the radial distance to 6.7 miles or less (Table 3.6-6).

During Phase 1, only one pile would be driven at a time, and no more than two piles would be installed per day during the 2- to 3-year construction period. Once construction is complete and pile driving has ceased, impacts would dissipate. Although pile-driving noise would propagate across a considerable area, the primary impacts on finfish and invertebrates would be temporary displacement from the affected area, recoverable injury, and temporary threshold shift. Individuals displaced by pile-driving noise would be expected to return to the affected area once the noise had ceased, and pile-driving noise would not likely have any measurable impact on populations of species subject to mortality from pile-driving noise. Therefore, there would be **minor** impacts on fish populations from pile driving because this activity would occur sporadically, the actual area of impact would be small in relation to the overall habitat and spatial distribution of fish populations in the region, and pile-driving noise would only occur over a relatively short period of time (i.e., approximately 2 to 3 hours per foundation or up to 6 hours per day).

A possible impact of pile-driving noise could be a change in the presence of HMS near the SWDA. If common fishes and invertebrates that constitute the main prey sources for tuna, sharks, and other HMS were driven away from the SWDA by noise, this could cause HMS to also abandon the area. Because the prey items would likely return once the noise has ceased, HMS would also be likely to return to their original behaviors and distributions. Due to their sensitive life history traits, invertebrates such as longfin squid that spawn once in a lifetime may be susceptible to a reduction in reproductive success and behavioral responses; however, the limited research available suggests pile-driving noise has little to no impact on their ability to sustain viable populations (Jones et al. 2021; Wilber et al. 2022). Therefore, impacts would be **minor** on finfish, invertebrates, and EFH.

Phase 1 trenching activities and burial methods are known to emit noise, comparable to those produced by use of vessels with DP thrusters. These disturbances are temporary, local, and extend only a short distance beyond the cable lay corridor. Impacts of this noise source are typically less prominent than the impacts arising from physical disturbance and subsequent sediment suspension. Noise due to trenching and burial would have **negligible** impacts on finfish, invertebrates, and EFH.

All other noise-producing activities under Phase 1 (i.e., G&G survey activity, vessel activity, WTG operations, cable trenching) would not be expected to exceed the impacts expected under Alternative A, as described in Section 3.6.2.1, and would, therefore, have **negligible** impacts.

Cable maintenance operations would be infrequent over the life of the proposed offshore wind sites; related noise impacts would be temporary, local, and extend only a short distance beyond the cable corridor, resulting in **negligible** impacts that are temporary, short, and spatially localized to the trenching/burial operations.

Noise associated with operations vessels would impact fish, invertebrates, and EFH in a similar way to construction vessel traffic (COP Appendix III-M, Section 1.4.1; Epsilon 2022a). However, the impacts would be smaller than construction because operations would generate fewer vessel trips, and many of the vessels used (i.e., crew transport vessels) would be smaller and used for shorter time periods. Mobile species/life stages within range of vessel noise capable of initiating physiological stress or noise-related impacts would likely move away from the source and not result in population-level consequences. BOEM (2018b) determined there would not likely be an impact from noise generated by vessel transit and operations, including noise generated by vessel engines and thrusters.

WTGs would also produce noise throughout operations, although sound levels are typically low (Madsen et al. 2006). Measurements of the Block Island Wind Farm operational noise registered at less than 100 dB re 1 μPa at 164 feet from the turbine, whereas background noise levels under calm conditions were up to 110 dB re 1 μPa at 164 feet from the turbine and 107 dB re 1 μPa at 18.6 miles from the turbine (HDR 2019a). According to the few available audiograms indicating fish thresholds for behavioral responses, this sound intensity would be barely detectable (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, respectively (Tougaard and Henrikson 2009), which is only slightly higher than the ambient noise levels recorded at the RI/MA Lease Areas from 2011 to 2015 (95 to greater than 104 dB re μPa) (Kraus et al. 2016a).When operational, WTGs would produce noise that can cause masking impacts, but thus far, noise related to operational WTGs have not been found to have an impact on finfish (English et al. 2017). The NMFS interim criterion for behavior impacts on fishes is 150 dB. In regard to invertebrates and sound, sensitivity thresholds for sound exposure have been established for few species. Mooney et al. (2016) reported evidence of behavioral responses and habituation to sound by longfin squid, and Przeslawski et al. (2018) assessed noise impacts on scallops. While no clear evidence of scallop mortality associated with seismic survey sound was found, the possibility of sub-lethal impacts was not assessed (Przeslawski et al. 2018). The lack of a swim bladder or any other gas bubble structure associated with hearing suggests that the ability of scallops to hear may be most similar to fish without swim bladders (Normandeau 2012). Eggs and larvae of fish are also sensitive to noise (Popper et al. 2014; Pyć et al. 2018).

Detection distance from noise generated by WTGs depends on several variables (i.e., hearing capability of fish, depth, size and spacing of WTGs, wind speed) and does not create a level of noise capable of injury (Wahlberg and Westerberg 2005). No study has shown any behavioral impact of sound during the operational phase of wind energy facilities. However, due to the lower sound emissions during operations, measurements and research remain a low priority in comparison with pile-driving sound (Thomsen et al. 2015). In light of reports of abundant finfish and invertebrates near WTG foundations (Causon and Gill 2018; English et al. 2017; ten Brink and Dalton 2018), it appears that noise from operating WTGs does not result in finfish and invertebrates avoiding WTGs or failing to thrive near them. Results from a study at the Block Island Wind Farm indicate a correlation between underwater sound levels and increasing wind speed, but this is not clearly influenced by turbine machinery; it may be the natural effects that wind and sea state have on underwater sound (Elliott et al. 2019; Urick 1983). A recent compilation of operational noise from several wind energy facilities with turbines up to 6.15 MW in nameplate capacity showed that operational noise generally attenuates rapidly with distance from the turbines, falling below normal ocean ambient noise within approximately 1 kilometer (0.6 mile) from the source. That compilation found that the combined noise levels from multiple turbines is lower or comparable to that generated by a small cargo ship (Tougaard et al. 2020). Based on the Tougaard et al. (2020) dataset, operational noise from jacket foundations could be louder than from monopiles due to the jacket foundation’s larger surface area interacting with the water. Additional data are needed to fully understand the impact of size, foundation type, and drive type on the amount of sound produced during turbine operation. Based on this and the above impacts associated with WTG and vessel noise, the noise impacts from Phase 1 would be **minor**.

The impacts of Phase 1 decommissioning would be similar to those described for construction, except for the absence of pile-driving noise. Complex habitat that may have developed around cable protection and WTG and ESP scour protection would be removed, resulting in a conversion of habitat type back to soft sediment. Structure-dependent finfish and invertebrate species would be the most affected by the decommissioning and removal of hard substrate (Claisse et al. 2014; Smith et al. 2016). The proposed decommissioning activities would reverse the artificial reef effect, converting approximately 109 acres (74 acres of WTG and ESP scour and 35 acres cable protection) from hard-bottom habitat back to soft-bottom habitat. However, remnants of the previous epifaunal hard-bottom organisms shell hash and other biogenic detritus accumulated over the 30 years of artificial reef development would remain on the seabed after decommissioning activities. The presence of these biogenic components would alter the characteristics of the seafloor under the removed wind energy facilities. This modification in benthic habitat resources would result in a long-term change from the existing conditions. The modification would be a primarily localized alteration of sediment characteristics in portions of the Phase 1 footprint that previously had hard protection. This change in sediment would not likely affect the ability of benthic habitat to support the biological community within the proposed Project area. Therefore, the impacts on finfish, invertebrates and EFH from Phase 1 decommissioning would be **negligible** to **moderate**.

Port utilization: Phase 1 construction would use existing East Coast port facilities, some of which would be upgraded to support the offshore wind industry as a whole (Section 3.6.2.1). No ports would specifically be expanded to support Phase 1 construction, and Phase 1 port utilization would not increase overall port utilization beyond the levels described for Alternative A. As a result, port utilization for Phase 1 construction would have **negligible** impacts on finfish, invertebrates, and EFH.

Operations and decommissioning are not anticipated to cause any port expansion or otherwise affect finfish, invertebrates, and EFH that are present near ports to be used under Alternative B, and impacts would be **negligible**.

Presence of structures: The presence of structures could affect finfish, invertebrates, and EFH through entanglement and gear loss/damage, hydrodynamic disturbance, fish aggregation, habitat conversion, and migration disturbances, as detailed in Section 3.6.2.1. Long-term habitat alteration would occur in the form of installation of the foundations, scour protection around the WTG and ESP foundations, and cable protection for the inter-array and export cables. Temporary habitat alteration would occur from activities associated with WTG and ESP construction of the inter-array and export cable. The total area of alteration within the SWDA due to Phase 1 foundation and scour protection installation, jack-up vessel use, inter-array and inter-link cable installation, and potential cable protection installation for Phase 1 is 502 acres, which is 0.4 percent of the SWDA (COP Appendix III-T, Table 2; Epsilon 2022a). The amount of bottom habitat altered within the OECC by cable protection would be approximately 22 acres or less. The total area of soft-bottom habitat impacted by Phase 1 is less than 0.00002 percent of available soft-bottom habitat in the geographic analysis area for finfish, invertebrates, and EFH. As discussed in Section 3.4, Benthic Resources, and Section 3.5, Coastal Habitats and Fauna, portions of the areas of hard-bottom habitat along the OECC could be converted to soft-bottom habitat during cable installation. The OECC installation and sand wave dredging along the route would result in a temporary disturbance of up to 263 acres and 52 acres of seafloor habitat, respectively.

Replacement of soft-bottom habitat with hard-bottom habitat would benefit some species (i.e., American lobster, Atlantic cod), while reducing habitat for others (i.e., winter flounder, American sand lance [*Ammodytes americanus*]). The installation of foundations and scour protection would cause some displacement of mobile finfish and invertebrate species that prefer soft-bottom habitat (i.e., flatfish). Sessile species (i.e., shellfish, demersal eggs) in the immediate area would likely be subject to mortality. Conversely, species preferring hard-bottom habitat (i.e., Atlantic cod, American lobster) would have increased habitat availability from scour protection around foundations. This could alter the distribution of species. However, temperature is expected to be a bigger driver of habitat occupation and species movement through the SWDA as a whole (Secor et al. 2018). Although the vertical surfaces on WTG and ESP monopiles would also introduce a source of new hard substrate, the dominant community after several years of succession is not anticipated to be highly diverse, based upon the almost singular colonization of foundations by blue mussels observed at the Block Island Wind Farm (HDR 2019a) and the dominance of blue mussels and/or sea anemones observed at wind energy facilities in the Belgian part of the North Sea (Kerckhof et al. 2019). New hard surfaces might provide a favorable substrate for exotic invasive species (Langhamer 2012), potentially leading to further impacts. There would be **moderate** impacts from the long-term conversion of habitat, although this could be beneficial for fishes and invertebrates that prefer hard-bottom communities. Impacts associated with long-term habitat alteration are an unavoidable consequence of construction. Because the long-term habitat alteration from soft to hard-bottom habitat would encompass a proportionally small area relative to the SWDA as a whole, these impacts are unlikely to have substantial impacts on populations in the SWDA, as displaced species would have large areas of preferred habitat available nearby (Guida et al. 2017; COP Volume II-A, Section 2.1.2.1 and Appendix II-I, Chart 2; Epsilon 2022a).

WTG and ESP foundations could affect pelagic species and life stages. A modeling study by Chen et al. (2016) found that WTGs in the 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 larvae. Using tank tests, Miles et al. (2017) recorded mean current flows reduced immediately downstream of an offshore wind monopile foundation but return to background levels within a distance proportional to the pile diameter. In a current-only regime, mean flows returned to within 5 percent of background levels within a radius of approximately 8.3 times the pile diameter. In a combined current and wave regime, flow returned to background levels within a radius of 3.5 times the pile diameter. The authors suggested that downstream impacts have a length scale of 8 to 10 times the pile diameter (Miles et al. 2017). Applied to Phase 1, this ratio suggests that background conditions would exist approximately 328 feet from each monopile foundation.

A recent study completed by BOEM assessed the ‘mesoscale’ effects of offshore wind energy facilities on coastal and oceanic environmental conditions and habitat by examining how oceanic hydrodynamics change after turbines are installed, particularly with regard to turbulent mixing, bed shear stress, and larval transport (Johnson et al. 2021). This study focused on the Massachusetts-Rhode Island marine areas, where proposed wind energy lease areas are in the licensing review process. Four post-installation scenarios were assessed, and two species of finfish (silver hake and summer flounder) and one invertebrate (Atlantic sea scallop) were selected as the focal species. Results indicated recordable changes to local hydrodynamics, including changes to temperature stratification due to increased mixing, increased flow resistance, and decreased current magnitude and wave height. Larval settlement was discernably increased or decreased based on these hydrodynamic changes for all three species. However, the authors concluded that the change in larval settlement due to the offshore wind facilities was not likely to impact regionally managed fishery stocks (Johnson et al. 2021).

Similar to Johnson et al. (2021), a model was recently completed to assess the wake-related wind speed deficits that occur in the lee of a wind farm (Christiansen et al. 2022). The study focused on the sea surface interference of single wake effects due to the recent upsurge in offshore wind energy production and resulting larger-scale disturbances in hydro- and thermodynamics in the southern and central North Sea. The results of the modeling effort indicated a reduction in sea surface currents and potentially a reduction in the temperature and salinity distribution and stratification within areas of wind farm operations. Changing wind directions were shown to inhibit severe local impact surrounding individual wind farms, but a potential cascading effect could occur in areas with clustered wind farms as proposed for the southern New England subregion. The potential change in surface water mixing could result in changes to biological productivity of the southern New England region. However, Christiansen et al. (2022) did not identify an overwhelming impact on the biological productivity of the German Bight. In comparison, other studies have concluded that wind farms could also increase the mixing of surface waters and deepen the thermocline, possibly increasing pelagic productivity in local areas (English et al. 2017), although this would likely have little effect on finfish and commercially important invertebrates. A field survey of a Dutch wind energy facility found no impact of the wind energy facility on bivalve recruitment (Bergman et al. 2010). Considering that potential impacts on the pelagic environment are likely to be non-measurable and localized, impacts of pelagic changes would be **negligible**.

Cable protection and scour protection around WTG and ESP foundations could create an artificial reef effect, attract a different community of fishes and invertebrates, and shift the habitat from a benthic soft-bottom to hard-bottom habitat, although this new habitat may or may not function similarly to naturally occurring hard-bottom habitat typical in the region (Kerckhof et al. 2019; HDR 2019a). Species preferring hard-bottom habitat (i.e., Atlantic cod, American lobster) would gain habitat, while soft-bottom species (summer flounder, Atlantic surf clam) would see habitat locally reduced. The 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 few years 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). For the Cape Wind Energy Project, the MMS did not anticipate the vertical monopile structures to provide a true artificial reef due to the material and low quantity of interstitial spaces available, in contrast to the rocky scour protection (MMS 2009); however, recent observations at the Block Island Wind Farm have reported considerable colonization by mussels (ten Brink and Dalton 2018). Similar to scour protection, the offshore export cable could require protection (e.g., rock or concrete mattresses) in places where it is not buried to the minimum target burial depth of 5 feet. However, the applicant has committed to prioritizing cable burial.

The potential impacts of wind energy facilities on offshore ecosystem functioning have been studied using simulations calibrated with field observations (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019). These studies indicate that wind energy facilities may increase bivalve biomass and shift local food webs toward a greater number of detritivores. They also indicated higher biomass for benthic fish and invertebrates and possibly for pelagic fish, marine mammals, and birds as well. Overall, omnivorous behavior, energy recycling, and general ecosystem activity were all predicted to increase after wind energy facility construction. This indicates that offshore wind energy facilities can generate beneficial impacts on local ecosystems.

In light of the above information, there would be **moderate** beneficial impacts associated with the reef effect, although impacts on a population level for most species should be minimal, based on the amount of habitat converted in relation to the overall habitat still available in the region.

One unexplored potential impact of offshore wind power facilities is that of the shadow flicker caused by rotating WTG blades. Although no study has assessed the impact of shadow flicker on finfish or invertebrates, it is possible that those species that perceive shadows as indicative of predators could be affected, especially when those individuals encounter shadow flicker while near the surface. Although this potential impact is currently hypothetical, its impact would likely be **negligible**.

While primarily an ongoing activity, regulated fishing effort can affect finfish, invertebrates, and EFH by modifying the nature, distribution, and intensity of fishing-related impacts (mortality, bottom disturbance). Phase 1 and other future offshore wind development could influence this IPF (Section 3.9), possibly influencing when, where, and to what degree fishing activities affect finfish, invertebrates, and EFH. 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 be **moderate**. To the degree that offshore wind development results in regulatory exclusion of some currently fished areas from future fishing, Phase 1 would have **moderate** beneficial impacts on finfish, invertebrate, and EFH resources in those areas.

Traffic: As discussed in Section 3.13, Phase 1 construction would generate an average of 22 and a maximum of 56 vessels operating in the geographic analysis area for navigation and vessel traffic at any given time, while Phase 1 construction would result in up to 4 vessels at a time. Although Phase 1 would result in an increase in regional vessel traffic above historical baseline averages, this is not expected to result in a significant increase in impacts related to vessel traffic. The impacts from vessel presence related to operations, monitoring surveys, and decommissioning activities on finfish, invertebrates, and EFH species would be short-term, localized, and **minor**.

Impacts of Phase 2

As described in this section, impact levels for Phase 2 are expected to be similar to those described for Phase 1 due to the use of similar construction and decommissioning techniques.

Phase 1 and Phase 2 would each result in a similar number of vessels performing similar operations, construction methods, and component infrastructure. Phase 2 would include up to 89 structures (up to 3 of which could be ESPs, with the remainder for WTGs) that would potentially use of bottom-frame foundations for WTGs and ESPs (COP Volume I, Section 4.2.1; Epsilon 2022a). As shown in Table C-3 in Appendix C, each bottom frame foundation would require up to 1.7 acres of scour protection, compared to 1.2 acres for monopiles and 1.6 acres for each jacket foundation. As a result, the impacts of Phase 2 would be marginally larger than, but substantively similar to, those described for Phase 1. Specifically, Phase 2 would have **negligible** to **minor** impacts on finfish, invertebrates, and EFH due to EMF; **negligible** impacts from IPFs for accidental releases, lighting, port utilization; **minor** impacts from anchoring and gear utilization, noise, and cable emplacement and maintenance; and **moderate** impacts from cable emplacement and maintenance, presence of structures, and climate change. Phase 2 construction would have **moderate** beneficial impacts on finfish, invertebrates, and EFH from the presence of structures and changes in regulated fishing effort.

If the applicant selects the SCV as part of the final Phase 2 design, some or all of the impacts on finfish, invertebrates, and EFH from the Phase 2 OECC through Muskeget Channel may not occur, while impacts along the SCV route would occur. The SCV would disturb up to 329 acres of seafloor, including approximately 41 acres of offshore export cable protection, but impacts would be localized, short term, and temporary. Based on available information, the impacts of SCV construction on finfish, invertebrates, and EFH would be similar to those for the Phase 2 OECC and range from **negligible** to **moderate**; impacts would be highest if EFH cannot be avoided. BOEM will provide a more detailed analysis of the SCV impacts on finfish, invertebrates, and EFH in a supplemental NEPA analysis.

Phase 2 operations would be similar to (and likely be combined with) Phase 1 operations and would, thus, result in **negligible** to **minor** impacts on finfish, invertebrates, and EFH. The **negligible** to **minor** impact of Phase 2 operations would not increase the impacts beyond that of Alternative A. Phase 2 decommissioning impacts are expected to be similar to those described for Phase 1 decommissioning and would range from **negligible** to **moderate**.

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-3 would contribute to impacts on finfish, invertebrates, and EFH through the primary IPFs of cable maintenance and emplacement, climate change, noise (especially pile driving), and the presence of structures. These impacts would primarily occur through seafloor disturbance, sedimentation, and dredging. Cumulative impacts would be similar to the impacts described for Alternative B but distributed across the entire geographic analysis area—especially in wind development areas. Overall, the cumulative impacts on finfish, invertebrates, and EFH would be **minor** to **moderate** and **minor** beneficial.

Conclusions

Impacts of Alternative B. Alternative B would have **negligible** to **moderate** impacts and **moderate** beneficial impacts on finfish, invertebrates, and EFH within the geographic analysis area based on all IPFs. Impacts from Alternative B would include temporary and long-term consequences resulting from habitat alteration, increased turbidity, sediment deposition, entrainment, increased noise, vessel strike, and EMF. Other impacts associated with Alternative B may occur as a consequence of routine activities after the applicant completes construction, although the impact of routine post-construction activities on fish, invertebrates, and EFH is likely to be **negligible**, based on the small fraction of the habitat within the SWDA and OECC that would be affected.

The impacts from Alternative B would range from **negligible** to **moderate**, including the presence of structures, which may also result in **moderate** beneficial impacts. The impact conclusions for ongoing and future non-offshore wind activities are presented in Section 3.6.2.1. The most prominent IPFs of Alternative B are expected to be cable emplacement and maintenance, presence of structures, noise (specifically from pile driving), and climate change. In general, the impacts are likely to be local and not alter the overall character of finfish, invertebrate, and EFH resources in the geographic analysis area. Despite mortality and temporary or permanent habitat alteration, the long-term impact on finfish, invertebrates, and EFH from construction of Alternative B would be **moderate**, as the impacts could be measurable on a site-level scale but not within the entire proposed Project area, and the resources would likely recover naturally over time. The applicant may elect to pursue a course of action within the PDE that would cause less impact than the maximum-case scenario evaluated above, but doing so would not likely result in different impact ratings than those described above.

The endangered Atlantic sturgeon, giant manta ray, and oceanic whitetip shark are the only finfish or invertebrate listed under the ESA that may be affected by the proposed Project. BOEM does not anticipate that any Atlantic sturgeon, giant manta rays, and oceanic whitetip sharks would be seriously injured or killed as a result of exposure to any IPF. Additionally, giant manta rays and oceanic whitetip sharks are considered rare within the geographic analysis area, so they would not be expected to be present at densities that would result in substantial impacts on either species. Atlantic sturgeon, giant manta rays, and oceanic whitetip shark may experience impacts of ongoing and planned activities. The most significant IPF for these listed species is likely to be noise from pile driving. Since the Atlantic sturgeon adults and subadults would most likely not be within the SWDA or OCEE during summer, when offshore construction is most likely to occur, impacts on individual Atlantic sturgeon if present offshore are expected to be limited to temporary behavioral disturbance.

The impacts of Alternative B were similarly addressed for ESA-listed fish species in the NMFS BA (BOEM 2022d). Table 3.6-7 summarizes the effects determinations for the listed marine mammals present within the geographic analysis area based on the analysis provided in the BA (BOEM 2022d) using the following definitions:

- **No Effect**: This is the appropriate determination when the action agency determines its Proposed Action is not expected to affect listed/proposed species or designated/proposed critical habitat.
- **May Affect, Not Likely to Adversely Affect**: This is the appropriate determination when effects on listed species are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are beneficial effects without any adverse effects. Insignificant effects relate to the size of the impact; the impact cannot be meaningfully detected, measured, or evaluated and should never reach the scale where take occurs. Discountable effects are those that are extremely unlikely to occur.
- **May Affect, Likely to Adversely Affect**: This is the appropriate determination when adverse effects that are not beneficial, insignificant, or discountable are likely to occur to listed species/critical habitat.

Table 3.6-7: Summary of Impacts Determination for Alternative B from the National Marine Fisheries Service Biological Assessment

Activity	Impact Type (IPF)	Potential Effect	Atlantic Sturgeon
Construction			
Inter-array and offshore export cable installation	Turbidity (presence of structures)	Foraging/prey availability	Not likely to adversely affect
Offshore export and inter-array cable installation, WTG installation	Benthic habitat loss (presence of structures)	Foraging/prey availability	Not likely to adversely affect
Steel anchor cables used on construction barges	Entanglement (presence of structures)	Injury/mortality	NA
Impact pile driving	Noise	PTS, behavioral disturbance	Likely to adversely affect
Vibratory pile driving	Noise	PTS, behavioral disturbance	Not likely to adversely affect
Vessel traffic	Noise	PTS, behavioral disturbance	Not likely to adversely affect
	Strike (traffic)	Injury/mortality	Not likely to adversely affect
Operations			
WTG	Noise	PTS, behavioral disturbance	Not likely to adversely affect
	Accidental releases	Physiological impacts, inhalation, surfacing in the sheen	Not likely to adversely affect
	Lighting	Photoperiod disruption, attraction	Not likely to adversely affect
	Presence of structures	Habitat alteration	Not likely to adversely affect
Offshore export and inter-array cables	EMF	Impacts on orientation, migration, navigation	Not likely to adversely affect
Vessel traffic	Noise	PTS, behavioral disturbance	Not likely to adversely affect
	Strike (traffic)	Injury/mortality	No effect
Decommissioning			
Removal of offshore export cable, WTG, and scour protection	Turbidity/benthic habitat loss (presence of structures)	Foraging/prey availability	Not likely to adversely affect
Vessel traffic	Noise	Behavioral disturbance	Not likely to adversely affect
	Strike (traffic)	Injury/mortality	Not likely to adversely affect
HRG and ROV for site clearance	Noise	PTS, behavioral disturbance	Not likely to adversely affect

EMF = electromagnetic fields; HRG = high-resolution geophysical; IPF = impact-producing factor; NA = not applicable; PTS = permanent threshold shift; ROV = remotely operated vehicle; WTG = wind turbine generator

Cumulative Impacts of Alternative B. The cumulative impacts of all IPFs from ongoing and planned activities, including Alternative B, would range from **negligible** to **moderate** with a **moderate** beneficial impact from the presence of structures until decommissioning. Alternative B combined with ongoing and planned activities are not anticipated to result in population consequences for listed finfish and invertebrate species.

3.6.2.4 Impacts of Alternative C – Habitat Impact Minimization Alternative on Finfish, Invertebrates, and Essential Fish Habitat

Alternatives C-1 and C-2, summarized below, would limit the number of export cables installed in the Eastern Muskeget route or Western Muskeget Variant but would not affect the number or placement of WTGs or ESPs for the proposed Project, compared to Alternative B. All other proposed Project components, including construction, operations, and decommissioning, would be identical to Alternative B:

- Alternative C-1 would avoid impacts on complex habitats in the Western Muskeget Variant by removing that route as an option for Phase 2. Under this alternative, all three Phase 2 export cables would be installed in the Eastern Muskeget route, as well as two cables for Phase 1.
- Alternative C-2 would limit the number of export cables installed in the Eastern Muskeget route to three (both Phase 1 cables and one Phase 2 cable) and would include installation of up to two cables in the Western Muskeget Variant. This would reduce impacts on complex habitats in the Eastern Muskeget route.

Alternatives C-1 and C-2 would reduce or avoid some impacts on finfish, invertebrates, and EFH during construction, operations, and decommissioning in either the Western Muskeget Variant or Eastern Muskeget route due to a decrease in the extent of cable installation in complex habitat areas, including the avoidance of cod habitat in the area avoided. This would reduce the impacts from IPFs for accidental releases, anchoring and gear utilization, EMF, lighting, cable emplacement and maintenance, noise, and presence of structures (i.e., scour protection and foundations) in the specific area avoided.

The Western Muskeget Variant would affect less seafloor acreage than the Eastern Muskeget route; however, the Western Muskeget Variant is comprised of complex seafloor only, while the Eastern Muskeget route is comprised of complex seafloor, hard coarse deposits, and soft bottom (Table 3.4-1). Because of the rare habitats provided by complex and hard coarse deposit seafloor types, avoidance of disturbance to these habitats would also result in lower impacts on finfish, invertebrates, and EFH (additional discussion is provided in Section 3.4).

Alternative C-1 would use only the Eastern Muskeget route, which would eliminate the impacts on finfish, invertebrates, and EFH in the Western Muskeget Variant. The Eastern Muskeget route contains more types of habitat than the Western Muskeget Variant, but less of the habitat is complex seafloor. Using only the Eastern Muskeget route in Alternative C-1 would, therefore, affect more habitat types and a wider variety of finfish and invertebrate species inhabiting these habitats (as well as EFH, where present) than if the Western Muskeget Variant alone were used. However, Alternative C-1 would affect less of the complex habitat compared to Alternative B (which includes the potential use of the Western Muskeget Variant).

Alternative C-2 could use both the Eastern Muskeget route and the Western Muskeget Variant and would, therefore, affect finfish, invertebrates, and EFH in complex seafloor, hard coarse deposits, and soft-bottom habitats across a larger area than Alternative C-1. Under Alternative C-2, dredging for Phase 2 cable installation could impact up to 73 acres and could include up to 274,800 cubic yards of dredged material (compared to 67 acres and 235,400 cubic yards for Alternative B and Alternative C-1). The impacts of Alternative C-2 on finfish, invertebrates, and EFH in the Eastern Muskeget route would be less than those under Alternative C-1, and potentially less than those of Alternative B because Alternative C-2 would involve installation of fewer cables in the Eastern Muskeget route. The impacts of Alternative C-2 on finfish, invertebrates, and EFH in the Western Muskeget Variant would be greater than those of Alternative C-1, due to the installation of up to two cables in that corridor (where no such cables would be installed under Alternative B or Alternative C-1). Overall, Alternative C-2 would have greater impacts than Alternative C-1 on finfish and invertebrates that use complex seafloor habitats and on EFH in those habitats due to impacts within both the Eastern and Western Muskeget.

Overall, the impacts of Alternatives C-1 and C-2 on finfish, invertebrates, and EFH would remain **negligible** to **moderate**, with **moderate** beneficial. Although Alternative C-1 would result in a slightly shorter cable route due to use of the Eastern Muskeget route only, compared to cable placement in both the Eastern Muskeget route and the Western Muskeget Variant, the differences in route length are not anticipated to be enough to reduce the potential impacts on finfish, invertebrates, and EFH, although the specific species and EFH affected would differ slightly due to the different habitat types present in each route.

Alternatives C-1 and C-2 would occur within the same overall environment (e.g., ongoing and future actions). Therefore, impacts would only vary if the alternatives' incremental contributions differ (i.e., significant reduction), although incremental impacts from Alternatives C-1 and C-2 are expected to be similar to those of Alternative B. Therefore, the impacts of Alternatives C-1 and C-2, when combined with previous, ongoing, and future actions, would range from **negligible** to **moderate**, the same as impact rating as Alternative B.

Impacts of Alternative C-1 and C-2 on ESA-Listed Species: The impact levels for Alternative C-1 and C-2 are expected to be the same as those described for Alternative B (Section 3.6.2.3) for ESA-listed species due to the use of similar construction and decommissioning techniques. Alternatives C-1 and C-2 would not increase impacts and are not anticipated to result in population consequences.

3.7 Marine Mammals

3.7.1 Description of the Affected Environment

3.7.1.1 Geographic Analysis Area

This section discusses marine mammal resources in the geographic analysis area, as described in Table D-1 in Appendix D, Geographical Analysis Areas, and shown on Figure 3.7-1. Specifically, this includes Scotian Shelf, Northeast Shelf, and Southeast Shelf LMEs. This broad geographic area includes the SWDA and OECC and is likely to capture the majority of the movement range for most species in this group. It is also inclusive of all areas that could be affected by the proposed Project's activities, including Nantucket Sound, areas south of Martha's Vineyard and Nantucket, and the RI/MA Lease Areas. Appendix D provides a detailed summary of existing conditions, while Appendix G describes anticipated impacts based on assessed IPFs of ongoing and future offshore activities other than offshore wind.

3.7.1.2 Marine Mammal Characteristics

Marine mammals are highly mobile animals that typically use the waters of the geographic analysis area for foraging and/or migration; temporally, some individuals may remain year-round in the area, while others are transitory or migratory. The spatial distributions of marine mammal species in the geographic analysis area are not uniform; some species are pelagic and occur farther offshore, some are coastal and found nearshore, and others occur in both near and offshore areas. Additionally, some species prefer waters of the OCS and shelf edge (defined as a region that straddles the continental shelf break [656-foot depth contour]), either seasonally or while feeding due to changes in the abundance and locations of their prey species; however, at other times of the year, these same species can occur in shallower depths closer to shore. Regarding terminology used to describe types of marine mammals herein, "pinnipeds" refers to seals; "odontocetes" refers to toothed whales, dolphins, and porpoises; "mysticetes" refers to baleen whales; and "cetaceans" is inclusive of odontocetes and mysticetes.

A total of 38 marine mammal species, which comprise 39 distinct management stocks, are known to occur year-round, seasonally, and/or incidentally on the Northwest Atlantic OCS, which encompasses the geographic analysis area (Table 3.7-1). This includes 6 mysticete whale; 28 odontocete whale, dolphin, and porpoise; 4 seal; and 1 manatee species. Current species abundance estimates can be found in NMFS marine mammal stock assessment reports (Hayes et al. 2019, 2020, 2021, 2022; Pace 2021). For these reports, data collection, analysis, and interpretation are conducted through marine mammal research programs at NOAA Fisheries Science Centers and by other researchers. For the endangered North Atlantic right whale (NARW; *Eubalaena glacialis*) stock assessment report, the right whale catalog and sightings database, which use data from a photo-identification recapture database for individual NARWs, is used with available records through January 2021. Descriptions of marine mammals found in the geographic analysis area are summarized in the COP for the proposed Project (Volume III, Section 6.7; Epsilon 2022a), which incorporates existing published literature, gray literature, and public reports. Abundance and density data maps are accessible from Duke University's Marine Geospatial Ecology Lab (MGEL 2022; Roberts et al. 2016b, 2022). These data also document a generally patchy and seasonally variable marine mammal species presence and population density in the Northwest Atlantic OCS region.

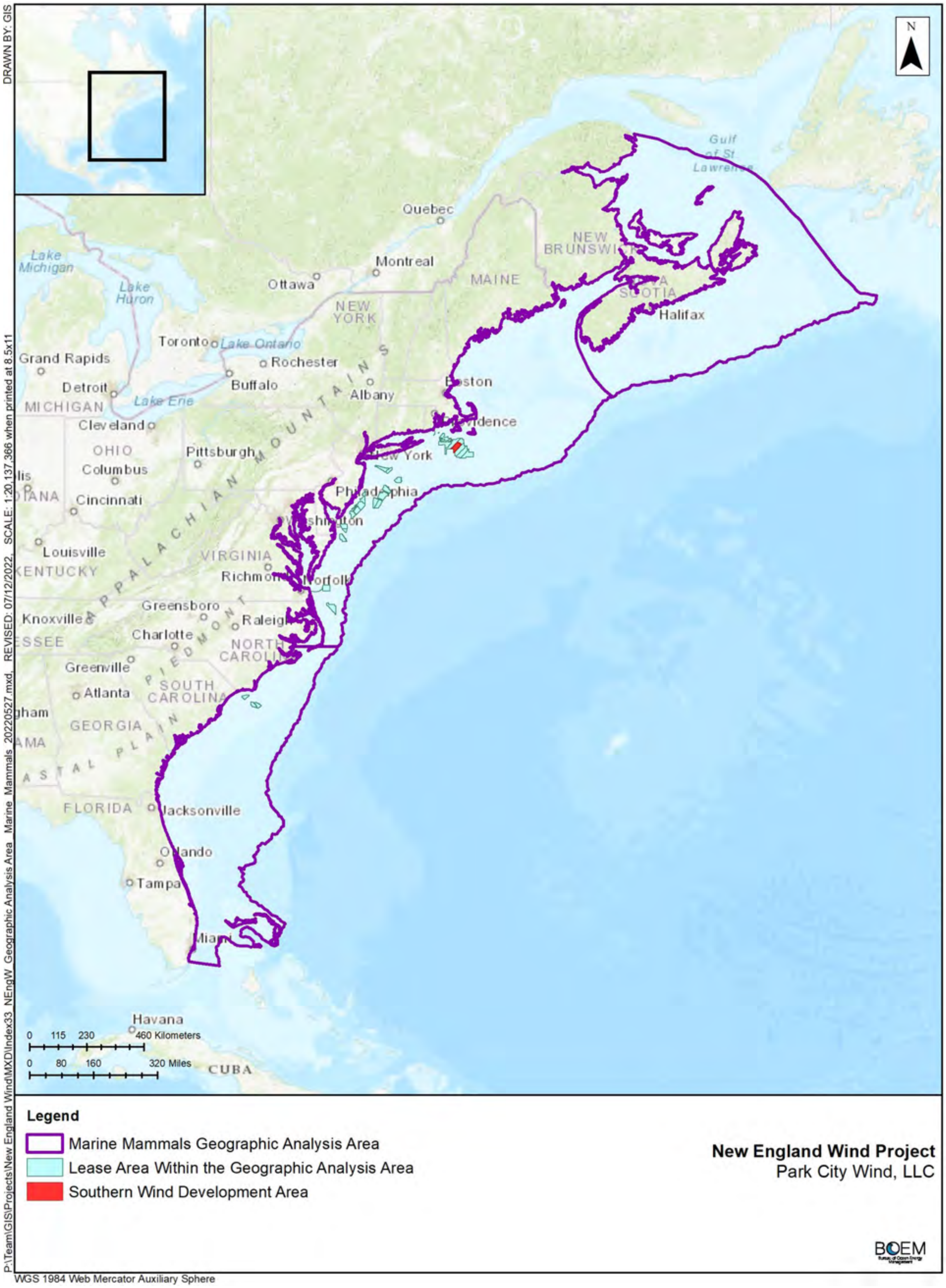

Figure 3.7-1: Geographic Analysis Area for Marine Mammals

Table 3.7-1 summarizes the presence, distribution, and population status of marine mammal species known to occur in and around the geographic analysis area. Table 3.7-2 presents average monthly and annual average marine mammal densities for the SWDA with a 50-kilometer (31-mile) buffer as described in the acoustic modeling report (COP Appendix III-M; Epsilon 2022a).

This section focuses on species and life stages of 16 of the 38 marine mammal species (16 out of 39 distinct management stocks) potentially present in the OECC and SWDA (Table 3.7-1). Specifically, this includes the species that would be likely to have regular or common occurrences in the proposed OECC and SWDA, based on the previously referenced abundance and density data (Roberts et al. 2016b, 2022) and published literature such as Kenney and Vigness-Raposa (2010). The time of year; level of activity; and duration of construction, operations, and decommissioning activities were important factors in determining which marine mammal species would likely be present at the time and place of the various activities associated with offshore wind development on the Atlantic OCS. Furthermore, species occurrence and density data were used to identify the subset of marine mammals for consideration and to estimate the distributions of those species. Among marine mammal species that may occur in this area, five are listed as endangered: NARW, blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), and sperm whale (*Physeter macrocephalus*). Data regarding the occurrence of marine mammals were collected by vessel, aerial, and acoustic survey methods. For marine mammal species identified as having a regular or common occurrence in the OECC and SWDA, specific descriptions and information are provided about data collection, marine mammal siting and stranding events, density data, and current conditions and trends for marine mammal occurrence. Additional information regarding life history characteristics and population status of additional marine mammal species is provided in Appendix B, Supplemental Information and Additional Figures and Tables.

Blue whales in the North Atlantic appear to target high-latitude feeding areas and may also use deep-ocean features such as sea mounts outside the feeding season (Pike et al. 2009; Lesage et al. 2017, 2018). Given their reported occurrence and habitat preferences, their presence in the geographic analysis area is uncommon (Waring et al. 2007, 2009, 2012, 2013). Additionally, sightings and strandings data indicate that blue whales occur along the U.S. East Coast continental shelf rarely, typically exhibiting a more pelagic distribution (NMFS 1998; Kraus et al. 2016b; Lesage et al. 2017). As such, blue whales are expected to be rare in the OECC and SWDA and, therefore, the co-occurrence of blue whales and proposed Project vessels is not expected at any appreciable levels of interaction. Further, the use of speed reductions and lookouts for all marine mammals make any impacts on blue whales extremely unlikely to occur. Therefore, potential impacts on blue whales from the proposed Project are not expected, and this species is not considered further in this EIS.

Beaked whales can occur in relatively high numbers in the Northwest Atlantic OCS region; however, this occurrence is usually offshore near the continental shelf edge (BOEM 2014c) outside of the OECC and SWDA, and they are not considered further in this EIS.

Details (e.g., biology, population status, life history, habitats, the threats they face, distribution, and conservation efforts) for the species that may be impacted by offshore wind development on the Atlantic OCS can be found in the proposed Project's COP (Volume III, Table 6.7-1; Epsilon 2022a), and through the following resources:

- NMFS Find a Species website (https://www.fisheries.noaa.gov/find-species)
- The Northeast Ocean Data Portal (https://www.northeastoceandata.org/data-explorer/?mammals-turtles)
- Ocean Biogeographic Information System-Spatial Ecological Analysis of Megavertebrate Populations species profiles (http://seamap.env.duke.edu/)
- NOAA Cetacean Density and Distribution Mapping Working Group (https://cetsound.noaa.gov/cda)

Table 3.7-1: Occurrence, Seasonality, and Population Status of Marine Mammal Species

Common Name (Family)	Scientific Name	Stock	Estimated Abundance[a]	Federal Regulatory Status[b]	Relative Occurrence in the SWDA[c]	Seasonal Occurrence in the SWDA
Baleen whales (Mysticeti)						
Blue whale[d]	*Balaenoptera musculus*	Western North Atlantic	402[e]	MMPA–strategic; ESA endangered	Rare	Winter
Fin whale[d]	*Balaenoptera physalus*	Western North Atlantic	6,802	MMPA–strategic; ESA endangered	Common	Year-round, peak spring-summer
Humpback whale[d]	*Megaptera novaeangliae*	Gulf of Maine (West Indies DPS)	1,396	MMPA–non-strategic[f]	Common	Year-round, peak spring-summer
Minke whale[d]	*Balaenoptera acutorostrata*	Canadian East Coast	21,968	MMPA–non-strategic	Common	Year-round, peak spring-fall
NARW[d]	*Eubalaena glacialis*	Western North Atlantic	368	MMPA–strategic; ESA endangered	Common	Year-round, peak spring
Sei whale[d]	*Balaenoptera borealis*	Nova Scotia	6,292	MMPA–strategic; ESA endangered	Regular	Spring-summer
Toothed whales (Odontoceti)						
Atlantic spotted dolphin[d]	*Stenella frontalis*	Western North Atlantic	39,921	MMPA–non-strategic	Uncommon	Year-round, peak spring-summer
Atlantic white-sided dolphin[d]	*Lagenorhynchus acutus*	Western North Atlantic	93,233	MMPA–non-strategic	Common	Year-round, peak spring-fall
Common bottlenose dolphin[d]	*Tursiops truncatus*	Western North Atlantic, Offshore[g]	62,851	MMPA–non-strategic	Common	Year-round
		Western North Atlantic, Northern Migratory Coastal	6,639	MMPA–strategic	Rare	—
Short-beaked common dolphin[d]	*Delphinus delphis*	Western North Atlantic	172,974	MMPA–non-strategic	Common	Year-round, peak summer-fall
Clymene dolphin	*Stenella clymene*	Western North Atlantic	4,237	MMPA–non-strategic	Rare	—
False killer whale	*Pseudorca crassidens*	Western North Atlantic	1,791	MMPA–non-strategic	Rare	—
Fraser’s dolphin	*Lagenodelphis hosei*	Western North Atlantic	Unknown	MMPA–non-strategic	Rare	—
Killer whale	*Orcinus orca*	Western North Atlantic	Unknown	MMPA–non-strategic	Rare	—
Long-finned pilot whale[d]	*Globicephala melas*	Western North Atlantic	39,215	MMPA–non-strategic	Uncommon	Year-round
Melon-headed whale	*Peponocephala electra*	Western North Atlantic	Unknown	MMPA–non-strategic	Rare	—
Pan-tropical spotted dolphin	*Stenella attenuata*	Western North Atlantic	6,593	MMPA–non-strategic	Rare	—
Pygmy killer whale	*Feresa attenuata*	Western North Atlantic	Unknown	MMPA–non-strategic	Rare	—

Common Name (Family)	**Scientific Name**	**Stock**	**Estimated Abundance[a]**	**Federal Regulatory Status[b]**	**Relative Occurrence in the SWDA[c]**	**Seasonal Occurrence in the SWDA**
Risso's dolphin[d]	*Grampus griseus*	Western North Atlantic	35,215	MMPA–non-strategic	Uncommon	Year-round
Rough-toothed dolphin	*Steno bredanensis*	Western North Atlantic	136	MMPA–non-strategic	Rare	—
Short-finned pilot whale	*Globicephala macrorhynchus*	Western North Atlantic	28,924	MMPA–non-strategic	Rare	—
Sperm whale[d]	*Physeter macrocephalus*	North Atlantic	4,349	MMPA–strategic; ESA endangered	Uncommon	Year-round, peak summer-fall
Spinner dolphin	*Stenella longirostris*	Western North Atlantic	4,102	MMPA–non-strategic	Rare	—
Striped dolphin	*Stenella coeruleoalba*	Western North Atlantic	67,036	MMPA–non-strategic	Rare	—
White-beaked dolphin	*Lagenorhynchus albirostris*	Western North Atlantic	536,016	MMPA–non-strategic	Rare	—
Beaked whales (Ziphiidae)						
Cuvier's beaked whale	*Ziphius cavirostris*	Western North Atlantic	5,744	MMPA–non-strategic	Rare	—
Blainville's beaked whale	*Mesoplodon densirostris*	Western North Atlantic	10,107[h]	MMPA–non-strategic	Rare	—
Gervais' beaked whale	*Mesoplodon europaeus*	Western North Atlantic	10,107[h]	MMPA–non-strategic	Rare	—
Sowerby's beaked whale	*Mesoplodon bidens*	Western North Atlantic	10,107[h]	MMPA–non-strategic	Rare	—
True's beaked whale	*Mesoplodon mirus*	Western North Atlantic	10,107[h]	MMPA–non-strategic	Rare	—
Northern bottlenose whale	*Hyperoodon ampullatus*	Western North Atlantic	Unknown	MMPA–non-strategic	Rare	—
Dwarf and pygmy sperm whales (Kogiidae)						
Dwarf sperm whale	*Kogia sima*	Western North Atlantic	7,750[i]	MMPA–non-strategic	Rare	—
Pygmy sperm whale	*Kogia breviceps*	Western North Atlantic	7,750[i]	MMPA–non-strategic	Rare	—
Porpoises (Phocoenidae)						
Harbor porpoise[d]	*Phocoena phocoena*	Gulf of Maine, Bay of Fundy	95,543	MMPA–non-strategic	Common	Year-round, peak fall-spring
Earless seals (Phocidae)						
Gray seal[d]	*Halichoerus grypus*	Western North Atlantic	27,300[j]	MMPA–non-strategic	Common	Year-round
Harbor seal[d]	*Phoca vitulina*	Western North Atlantic	61,336	MMPA–non-strategic	Common	Year-round
Harp seal	*Pagophilus groenlandicus*	Western North Atlantic	Unknown[k]	MMPA–non-strategic	Uncommon	—
Hooded seal	*Cystophora cristata*	Western North Atlantic	Unknown	MMPA–non-strategic	Rare	—
Sea cows (Sirenia)						
West Indian manatee (Florida subspecies)	*Trichechus manatus latirostris*	Florida	4,834[l]	MMPA–strategic; ESA threatened[c,m]	Rare	—

DPS = distinct population segment; ESA = Endangered Species Act; MMPA = Marine Mammal Protection Act; NARW = North Atlantic right whale; NMFS = National Marine Fisheries Service; NOAA = National Oceanic and Atmospheric Administration; OECC = offshore export cable corridor(s); PBR = potential biological removal; SWDA = Southern Wind Development Area; USEPA = U.S. Environmental Protection Agency
— = Species are expected to be rare in the SWDA and are, therefore, not discussed further in this assessment.
[a] Unless otherwise noted, best available abundance estimates are from NMFS stock assessment reports (Hayes et al. 2019, 2020, 2021, 2022; Pace 2021).
[b] This denotes the highest federal regulatory classification. A strategic stock is defined as any marine mammal stock:

[1] for which the level of direct human-caused mortality exceeds the PBR level;
[2] that is declining and likely to be listed as threatened under the ESA; or
[3] that is listed as threatened or endangered under the ESA or as depleted under the MMPA (NMFS 2021e).

[c] Relative occurrence, as defined in COP Section 6.7.1.1 (Volume III; Epsilon 2022a) and using published literature and density estimates as referenced in COP Section 6.7.1 (Volume III; Epsilon 2022a), is as follows:

Common: the species occurs consistently in moderate to large numbers.
Regular: the species occurs in low to moderate numbers on a regular basis or seasonally.
Uncommon: the species occurs in low numbers or on an irregular basis.
Rare: there are limited species records for some years; range includes the SWDA but due to habitat preferences and distribution information, species are not expected of occur in the SWDA. Records may exist for adjacent waters.

[d] This indicates species that would be likely to have regular or common occurrences in the proposed Project OECC and SWDA.
[e] No best population estimate exists for the blue whale; the minimum population estimate is presented in this table (Hayes et al. 2021).
[f] The humpback whale was previously federally listed as endangered; however, based on the revised listing completed by NOAA Fisheries in 2016 (81 Fed. Reg. 62259 [October 11, 2016]), the DPS of humpback whales that occurs along the U.S. East Coast, the West Indies DPS, is no longer considered endangered or threatened.
[g] Bottlenose dolphins occurring in the SWDA likely belong to the Western North Atlantic Offshore stock (Hayes et al. 2021).
[h] This estimate includes all undifferentiated Mesoplodon spp. beaked whales in the Atlantic (Hayes et al. 2021).
[i] This estimate includes both dwarf and pygmy sperm whales (Hayes et al. 2021).
[j] This is an estimate of gray seal population in U.S. waters. Data are derived from pup production estimates; Hayes et al. (2019, 2020, 2021) notes that uncertainty about the relationship between whelping areas along with a lack of reproductive and mortality data make it difficult to reliably assess the population trend.
[k] Hayes et al. (2021) report insufficient data to estimate the population size of harp seals in U.S. waters; the best estimate for the whole population is 7.4 million.
[l] There is no statistically significant population estimate available for the West Indian manatee, Florida subspecies. The subspecies’ minimum population size is presented in this table (USFWS 2014). The current range-wide population estimate for the West Indian manatee (all subspecies) is 13,000 (USFWS 2019).
[m] The West Indian manatee, including the Florida manatee subspecies, was previously federally listed as endangered; however, based on the revised listing completed by the USEPA in 2017 (82 Fed. Reg. 16668 [May 5, 2017]), the West Indian manatee, including all its subspecies, was reclassified as threatened and is no longer considered endangered under the ESA.

Table 3.7-2: Average Monthly and Annual Average Marine Mammal Densities for May to December in the Southern Wind Development Area and a 50-Kilometer Buffer[a]

Common Name	Scientific Name	Monthly Average Densities (Individuals/km^2)[b]												Annual Mean Density
		January	February	March	April	May	June	July	August	September	October	November	December	(Individuals per km^2)
Mysticetes														
Fin whale[b]	*Balaenoptera physalus*	0.0024	0.0024	0.0027	0.0047	0.0046	0.0047	0.0049	0.0045	0.0039	0.0026	0.0021	0.0021	0.0035
Humpback whale	*Megaptera novaeangliae*	0.0005	0.0003	0.0006	0.0022	0.0025	0.0026	0.0015	0.0009	0.0027	0.0021	0.0012	0.0008	0.0015
Minke whale	*Balaenoptera acutorostrata*	0.0008	0.0010	0.0010	0.0023	0.0038	0.0034	0.0013	0.0009	0.0009	0.0011	0.0004	0.0006	0.0015
NARW[b]	*Eubalaena glacialis*	0.0073	0.0086	0.0091	0.0098	0.0039	0.0003	0.0000	0.0000	0.0000	0.0001	0.0006	0.0035	0.0036
Sei whale[b]	*Balaenoptera borealis*	0.0000	0.0000	0.0000	0.0006	0.0005	0.0003	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0002
Odontocetes														
Atlantic spotted dolphin	*Stenella frontalis*	0.0000	0.0000	0.0000	0.0002	0.0004	0.0007	0.0013	0.0018	0.0018	0.0025	0.0009	0.0001	0.0008
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	0.0422	0.0244	0.0255	0.0530	0.0955	0.0876	0.0541	0.0284	0.0333	0.0470	0.0517	0.0604	0.0503
Common bottlenose dolphin (offshore)	*Tursiops truncatus*	0.0091	0.0025	0.0010	0.0172	0.0200	0.0530	0.1058	0.0858	0.0979	0.0814	0.0412	0.0197	0.0445
Short-beaked common dolphin	*Delphinus delphis*	0.2234	0.0642	0.0313	0.0599	0.0948	0.1199	0.1031	0.1481	0.2050	0.2516	0.1902	0.2956	0.1489
Harbor porpoise	*Phocoena phocoena*	0.0510	0.0822	0.1393	0.1011	0.0539	0.0161	0.0118	0.0121	0.0088	0.0077	0.0271	0.0297	0.0451
Long-finned pilot whale[c]	*Globicephala melas*	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061
Short-finned pilot whale[c]	*Globicephala macrorhynchus*	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045
Risso's dolphin	*Grampus griseus*	0.0006	0.0004	0.0002	0.0002	0.0005	0.0007	0.0016	0.0030	0.0019	0.0007	0.0007	0.0012	0.0010
Sperm whale[b]	*Physeter macrocephalus*	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0005	0.0004	0.0002	0.0002	0.0001	0.0001	0.0002
Pinnipeds														
Gray seal[d]	*Halichoerus grypus*	0.0487	0.0387	0.0389	0.0798	0.0785	0.0245	0.0055	0.0028	0.0032	0.0067	0.0161	0.0519	0.0329
Harbor seal[d]	*Phoca vitulina*	0.1095	0.0869	0.0873	0.1792	0.1764	0.0551	0.0122	0.0063	0.0073	0.0151	0.0361	0.1166	0.0740
Harp seal[d]	*Pagophilus groenlandicus*	0.0487	0.0387	0.0389	0.0798	0.0785	0.0245	0.0012	0.0028	0.0032	0.0067	0.0161	0.0519	0.0329

Source: Park City Wind 2022

km^2 = square kilometers; ESA = Endangered Species Act; SWDA = Southern Wind Development Area

[a] The 50-kilometer (31-mile) buffer surrounding the SWDA is intended to be inclusive of the full potential area of ensonification for noise-producing proposed Project activities, as described in the underwater acoustic modeling report (COP Appendix III-M; Epsilon 2022a).

[b] This denotes an ESA-listed species.

[c] Long- and short-finned pilot whale densities are the annual pilot whale guild density scaled by their relative abundances.

[d] Gray and harbor seal densities are the seals guild density scaled by their relative abundances; gray seals are used as a surrogate for harp seals.

Marine mammal stock assessment reports for 2020 (Hayes et al. 2021) and 2021 (Hayes et al. 2022) indicate that there are insufficient statistically significant data to determine population trends for most marine mammal species regularly found on the Northwest Atlantic OCS. However, data show the population of the endangered NARW declined in abundance from 2011 to 2020. Recruitment of new individuals from births remains low, with mortalities exceeding births by 3:2 during the 2017 to 2020 timeframe (Pettis et al. 2021). Births in 2021 were higher than in 2020, though, mortalities continue to exceed the species' calculated potential biological removal (PBR)[15] (Hayes et al. 2022; Pettis et al. 2021, 2022). The current PBR for NARWs is 0.7 individuals, whereas the total annual observed mortality/serious injury (M/SI) is 7.7 individuals (Hayes et al. 2022), as shown in Table 3.7-3. Not all mortalities are detected (Hayes et al. 2022), and overall mortality is likely higher than estimated (Pace 2021). Most recent data continue to indicate substantial population decline; the current population estimate for NARWs is at its lowest point in nearly 20 years, with a best-estimated 368 individuals remaining (Hayes et al. 2022; Pettis et al. 2022). The humpback whale (*Megaptera novaeangliae*) was previously federally listed as endangered. However, based on the revised listing completed by NOAA in 2016, the DPS of humpback whales that occurs along the East Coast of the United States (West Indies DPS) is no longer considered endangered or threatened (Hayes et al. 2020, 2021). The Gulf of Maine humpback whale stock continues to experience a positive trend in abundance (Hayes et al. 2020). An unusual mortality event (UME) for NARWs (NMFS 2022a), minke whales (NMFS 2022b), humpback whales (NMFS 2022c), and the Florida manatee (*Trichechus manatus latirostris;* NMFS 2022d) is ongoing within the geographic analysis area. A Northeast pinniped UME was established for harbor seal (*Phoca vitulina)* and gray seal (*Halichoerus grypus)* populations along the southern and central coast of Maine in June 2022 (NMFS 2022e). Table 3.7-3 presents current population trends, as well as calculated PBR and observed M/SI for marine mammal species that commonly occur within the geographic analysis area.

Long-term data from the Atlantic Marine Assessment Program for Protected Species (AMAPPS) includes both aerial and shipboard surveys designed to assess abundance and distribution trends of marine mammals, sea turtles, and seabirds (NMFS 2021f). At least one survey was conducted in the RI/MA Lease Areas in each survey year (2010 through current) and are used to inform NMFS abundance estimates and stock assessment reports referenced in this assessment. Higher abundance estimates were modeled for late spring through early summer for humpback whale, sei whales, minke whales, sperm whales, Atlantic white-sided dolphins (*Lagenorhynchus acutus*), and short-beaked common dolphins (*Delphinus delphis*), whereas relatively consistent seasonal abundance was demonstrated for fin whales, long-finned pilot whales (*Globicephala melaena*), short-finned pilot whales (*Globicephala macrorhynchus*), and Atlantic spotted dolphins (*Stenella frontalis*); higher late-summer abundances were evident for Risso's dolphins (*Grampus griseus*) and harbor porpoises (*Phocoena phocoena*) (Palka et al. 2017). AMAPPS survey results likewise indicate a preference for deeper offshore waters for pygmy and dwarf sperm whales (*Kogia breviceps* and *Kogia sima*), beaked whales, and striped dolphins (*Stenella coeruleoalba*) (Palka et al. 2017).

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[15] The calculated PBR is the maximum number of animals, not including in natural mortalities, which may disappear annually from a marine mammal stock while allowing that stock to reach or maintain its optimal sustainable population level.

Table 3.7-3: Potential Biological Removal, Total Observed Annual Human-Caused Mortality and Serious Injury, and Population Trends for Marine Mammal Species with Requested Take in Letter of Authorization Application for the Proposed Project

Common Name (Family)	Scientific Name	Stock	Estimated Abundance[a]	PBR[b]	Total Observed Annual Human-Caused M/SI[c]	Current Population Trend[d]
Baleen whales (Mysticeti)						
Fin whale[e]	*Balaenoptera physalus*	Western North Atlantic	6,802	11	1.8	NC
Humpback whale	*Megaptera novaeangliae*	Gulf of Maine	1,396	22	12.15[f]	2.8% increase per year from 2000 to 2016[g]
Minke whale	*Balaenoptera acutorostrata*	Canadian East Coast	21,968	170	10.6[f]	NA
NARW[e]	*Eubalaena glacialis*	Western North Atlantic	368	0.7	7.7[f]	23.5% decline from 2011 to 2019[h]
Sei whale[e]	*Balaenoptera borealis*	Nova Scotia	6,292	6.2	0.8	NC
Toothed whales (Odontoceti)						
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Western North Atlantic	93,233	544	227	NC
Atlantic spotted dolphin	*Stenella frontalis*	Western North Atlantic	39,921	320	0	NC
Common bottlenose dolphin	*Tursiops truncatus*	Western North Atlantic, Offshore	62,851	519	28	NC
		Western North Atlantic, Northern Migratory Coastal	6,639	48	12.2–21.5	NC
Short-beaked common dolphin	*Delphinus delphis*	Western North Atlantic	172,974	1,452	390	NC
Risso's dolphin	*Grampus griseus*	Western North Atlantic	35,215	301	34	NC
Long-finned pilot whale	*Globicephala melas*	Western North Atlantic	39,215	306	9	NC
Short-finned pilot whale	*Globicephala macrorhynchus*	Western North Atlantic	28,924	236	136	NC
Sperm whale	*Physeter macrocephalus*	North Atlantic	4,349	3.9	0	NC
Porpoises (Phocoenidae)						
Harbor porpoise	*Phocoena*	Gulf of Maine, Bay of Fundy	95,543	851	164	NC
Earless seals (Phocidae)						
Gray seal	*Halichoerus grypus*	Western North Atlantic	27,300	1,389	4,453[f]	NC
Harbor seal	*Phoca vitulina*	Western North Atlantic	61,336	1,729	339[f]	NC

M/SI = mortality and serious injury; NARW = North Atlantic right whale; NC = not conclusive; NMFS = National Marine Fisheries Service; PBR = potential biological removal; UME = unusual mortality event

[a] Best available abundance estimates are from NMFS stock assessment reports (Hayes et al. 2019, 2020, 2021, 2022; Pace 2021).

[b] The calculated PBR is the maximum number of animals, not including in natural mortalities, which may disappear annually from a marine mammal stock while allowing that stock to reach or maintain its optimal sustainable population level.

[c] The total observed annual M/SI is the sum of detected human-caused mortalities and serious injuries resulting from interactions with fisheries (i.e., entanglements) and vessel strikes, averaged over a 4-year period. Total annual M/SI rates are negatively biased and likely an underestimate, as not all mortalities are detected and reported.

[d] Based on NMFS stock assessment reports (Hayes et al. 2019, 2020, 2021, 2022; Pace 2021), current data are unable to support a statistically robust population trend analysis for species listed with “NC”. Therefore, an assessment of “increasing,” “decreasing,” and/or “stable” is not supported at this time for these species.

[e] This indicates an ESA-listed species.

[f] This indicates an ongoing UME (NMFS 2022a, 2022b, 2022c, 2022d, 2022e).

[g] Abundance increased 2.8% from the years 1990–2011, followed by a significant decrease in mean survival rates beginning in 2010, which correlated with a considerable change in habitat use by NARWs (Hayes et al. 2022; Pace 202)1.

[h] Mean growth derived from abundance estimates for the years 2000–2016 (Hayes et al. 2022; Robbins and Pace 2018).

Marine mammals use the coastal waters of the Northwest Atlantic OCS for a variety of biologically important functions such as resting, foraging, mating, avoiding predators, and migration (Madsen et al. 2006; Weilgart 2007). Seasonal migration between foraging and nursery grounds determines the biogeography of marine mammals in the Northwest Atlantic. The availability and abundance of prey items, which is itself influenced by regional oceanographic conditions, determines these movement patterns. The mixing in the Gulf of Maine of cold, fresh Scotian Shelf water and warm, saltier slope water that enters the gulf via the Northeast Channel forms the main water mass affecting the New England Shelf. Water temperatures at a depth of 112 feet near the proposed SWDA varied between 35 and 75°F from October 2009 to July 2010 (Ullman and Codiga 2010). These conditions affect zooplankton abundance and distribution.

Waters off the northeast United States, including southern New England and the SWDA, represent important feeding habitats for several species of baleen whales, such as NARW, humpback, fin, and minke whales (Hayes et al. 2019). These species undertake yearly migrations between their winter breeding grounds in southern latitudes and summer feeding grounds in northern latitudes, though not all individuals of a population migrate every year. The primary prey source for baleen whales is generally zooplankton and small schooling fish. Seasonal trends in overall zooplankton abundance have been detected over the shelf waters of southern New England, ranging from relatively low densities (12 to 23 cubic centimeters per 100 cubic meters) in January through February to relatively high densities (greater than 55 cubic centimeters per 100 cubic meter) during May through August (NEFSC 2018b). These trends are also present in one of the most abundant and widespread zooplankton species on the Northeast U.S. Shelf, *Calanus finmarchicus,* which is an important food source for many fish species and for NARWs. On average, *Calanus finmarchicus* has been the most abundant during the spring and summer (March through August), with the peak density in May through June along the Northeast U.S. Shelf (NEFSC 2018b). Levels of zooplankton biovolume have been remarkably consistent over the past 20 years with some interannual variability. However, mean total density for *Calanus finmarchicus* along the Northeast U.S. Shelf varied greatly from year to year, commonly halving or doubling from one year to the next (NEFSC 2018b).

Fin whales are common in continental shelf waters of the geographic analysis area north of Cape Hatteras, North Carolina, and can occur year-round in the vicinity of the proposed Project area, though seasonal densities are highest in the spring through summer (Kenney and Vigness-Raposa 2010; Hayes et al. 2022). Sei whales have been sighted in the summer in continental shelf waters of the northeastern United States, with irregular movements that appear to be associated with oceanic fronts, sea surface temperatures, and specific bathymetric features (Olsen et al. 2009; Hayes et al. 2022). Humpback whales can be found in New England waters throughout the year, but their numbers decrease in winter when most animals migrate to their more southerly calving and breeding grounds (Hayes et al. 2020). Sperm whales have been observed during scientific surveys conducted in summer over the continental shelf edge, over the continental slope, and into mid-ocean regions but are not common in shelf waters in or near the proposed Project area (Hayes et al. 2020). Multiple dolphin species, such as the Atlantic white-sided dolphin, common bottlenose dolphin (*Tursiops truncates*), and short-beaked common dolphin, are common in waters in and around the proposed Project area; short-beaked common dolphins were the most frequently observed dolphin species in aerial surveys conducted from 2011 to 2015 in the RI/MA Lease Areas (Kraus et al. 2016b). The offshore morphotype[16] of common bottlenose dolphin is distributed primarily along the OCS and continental slope in the northwest Atlantic Ocean, including the proposed Project area, and is the only type expected to be encountered in the proposed Project area (Hayes et al. 2020). Risso's dolphins and long-finned pilot whales are present in the Northwest Atlantic OCS but typically in association with unique bathymetric features such as the shelf edge and George's Bank. The

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[16] A morphotype is any of a group of different types of individuals of the same species in a population.

harbor porpoise is abundant throughout the coastal waters of the U.S. East Coast and are most likely to be encountered from spring through fall in nearshore waters of the proposed Project area (Hayes et al. 2022). Two seal species, the harbor seal and gray seal, are also commonly present in nearshore waters of the proposed Project area (Hayes et al. 2022).

The habitat within the geographic analysis area may play a role in the reproductive cycle for multiple species (Leiter et al. 2017; Stone et al. 2017). Stone et al. (2017) documented 27 sightings of cetaceans with their young, including humpback whales, fin whales, sei whales, minke whales, NARWs, pilot whales, common bottlenose dolphins, and short-beaked common dolphins. Humpback whales had the highest number of sightings with calves present.

NARWs have the potential to occur in the geographic analysis area year-round. The relative abundance and density of NARWs is highest in the winter and spring within the RI/MA Lease Areas, with individuals typically arriving in December and departing by May (Kenney and Vigness-Raposa 2010; Kraus et al. 2016b; Leiter et al. 2017; Quintana-Rizzo et al. 2021). The species is less commonly observed in the proposed Project area during July, August, and September when they are at more northern feeding grounds such as the Gulf of Maine/Bay of Fundy and Gulf of St. Lawrence (Pendleton et al. 2012; Kraus et al. 2016b; Leiter et al. 2017; Crowe et al. 2021). A recent increase in habitat use and year-round presence of the southern New England region, including the proposed Project area, indicates that the area is an increasingly important NARW habitat (O'Brien et al 2022). Surveys indicate that there are several areas where NARWs congregate seasonally, which include waters adjacent and northeast of the geographic analysis area. New England waters are important feeding habitats for NARW that must locate and exploit dense patches of zooplankton to feed efficiently and meet biological and energetic requirements (Fortune et al. 2013). These dense zooplankton patches are a primary driver in NARW distribution and habitat use within their northern latitude foraging grounds (Kenney et al. 1986; Pendleton et al. 2012; Pershing et al. 2009). Notably, mean total density for the copepod *Calanus finmarchicus*, the NARW's preferred zooplankton prey species, along the Northeast U.S. Shelf can vary greatly from year to year (Grieve et al. 2017). NARW distribution and patterns of habitat use has also shifted both spatially and temporally beginning in 2010 (Davis et al. 2017), likely in response to shifting prey resources. Fewer individuals appear to the Great South Channel and Bay of Fundy, whereas larger numbers have been seen in Cape Cod Bay and the region south of Martha's Vineyard and Nantucket (Leiter et al. 2017; Stone et al. 2017). This considerable change in observed NARW habitat use has the potential to expose the population to new and/or different anthropogenic threats (Hayes et al. 2018).

Elevated NARW mortalities have occurred since June 7, 2017. A total of 34 confirmed dead stranded whales, with an additional 20 live free-swimming whales with serious injuries due to entanglement or vessel strike, have been documented to date (NMFS 2022a). Human interactions (e.g., fishery-related entanglements and vessel strikes) are the most likely cause of this UME. In addition to this recent UME, the reproductive output for the species has declined by 40 percent since 2010 (Kraus et al. 2016b). Recent evidence suggests that the proportion of NARW mortality attributed to fishing gear entanglement, and overall mortality is likely higher than previously estimated (Pace 2021). Eighteen mother/calf pairs were documented during the 2021 calving season, up from ten during the previous year (Pettis et al. 2022). Despite the recent optimistic number of births, the species continues to be in severe decline, which prompted the International Union for Conservation of Nature to update the species' red list status in July 2020 from endangered to critically endangered, noting its high risk for global extinction. Additional information about the current population status for NARWs is provided in Hayes et al. 2022.

NMFS has designated two critical habitat areas in U.S. waters for the NARW under the ESA: the Gulf of Maine/Georges Bank region and the southeast calving grounds from North Carolina to Florida (81 Fed. Reg. 4837). The Gulf of Maine/Georges Bank critical habitat region is adjacent to the geographic analysis area but does not overlap. Two critical habitat areas for NARWs are also defined in Canadian waters (Brown et al. 2009). Critical habitat is designated for the West Indian manatee (*Trichechus manatus* *latirostris*) (42 Fed. Reg. 47840); however, no manatee critical habitat is located within the geographic analysis area. The offshore waters of southern New England, including waters in and near the geographic analysis area, are used as a migration corridor for NARWs and are considered a biologically important area for migrations between their feeding grounds off the Northeast United States and calving grounds off the Southeast United States (LaBrecque et al. 2015).

3.7.1.3 Current Trends

Marine mammals in the geographic analysis area are subject to a variety of ongoing human-caused impacts, including entanglement with fishing gear, fisheries bycatch, collisions with vessels (ship strikes), anthropogenic noise, pollution, disturbance of marine and coastal environments, impacts on benthic habitats, accidental oil and fuel leaks or spills, waste discharges, whaling/hunting, and climate change (Hayes et al. 2020). Climate change has the potential to impact the distribution and abundance of marine mammal prey due to changing water temperatures, ocean currents, and increased acidity (BOEM 2019f). Many marine mammal migrations cover long distances, and these factors individually and cumulatively can affect individuals over broad geographical and temporal scales.

Commercial fisheries occurring in the southeastern New England region include bottom trawl, mid-water trawl, dredge, gillnet, longline, and pots and traps (COP Volume III; Epsilon 2022a). Targeted fisheries species include monkfish, scallop, surf clam (*Spisula solidissima*)/hard clam (*Mercenaria mercenaria*), squid, mackerel, Atlantic herring (*Clupea harengus*), and lobster, among others. Entanglement in fishing gear is a substantial ongoing threat to marine mammals. Fisheries interactions are likely to have demographic impacts on marine mammal species, with estimated global mortality exceeding hundreds of thousands of 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 (Benaka et al. 2019; Lewison et al. 2014). Entanglement in fishing gear has been identified as one of the leading causes of mortality in NARWs and may be a limiting factor in the species recovery (Knowlton et al. 2012; NMFS 2022a). Entanglement may also be responsible for high mortality rates in other large whale species (Hayes et al. 2021; Read et al. 2006). Additionally, bottom trawling and benthic disruption have the potential to result in impacts on prey availability and distribution. However, as discussed below, the distribution of fishing effort may change due the presence of offshore wind facilities on the OCS.

There is a relatively low volume of vessel transits within the SWDA, and the most common type of vessels in the SWDA are commercial fishing vessels, either in transit or actively fishing (COP Volume III, Section 7.8.1.1, Table 7.8-1; Epsilon 2022a). Vessel traffic density along the OECC and the Western Muskeget Variant is also relatively low, though higher in comparison to the furthest offshore points of the SWDA, with the highest concentration of traffic midway through Nantucket Sound (COP Volume III, Section 7.8.1.1; Epsilon 2022a). 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 U.S. and Canadian eastern seaboard (Kite-Powell et al. 2007).

Marine mammals in the RI/MA Lease Areas are regularly subjected to commercial shipping and other vessel traffic and may be habituated to vessel noise (BOEM 2014c). Kraus et al. (2016a) recorded ambient sound in the frequency range of 71 to 224 Hz, with root-mean-squared sound pressure levels (SPL) ranging from 96 to 103 dB referenced to 1 micropascal (dB re 1 μPa) during 50 percent of recording time in the RI/MA Lease Areas from 2011 to 2015. SPLs were 95 dB re 1 μPa or less 40 percent of the time and greater than 104 dB re 1 μPa 10 percent of the time.

These ongoing impacts on marine mammals are expected to continue regardless of the offshore wind industry.

3.7.2 Environmental Consequences

Definitions of potential impact levels for marine mammals are provided in Table 3.7-4. Impact levels are intended to serve NEPA purposes only, and they are not intended to incorporate similar terms of art used in other statutory or regulatory reviews. For example, the term “negligible” is used for NEPA purposes as defined here and is not necessarily intended to indicate a negligible impact or effect under the MMPA. Similarly, the use of “detectable” or “measurable” in the NEPA significance criteria is not necessarily intended to indicate whether an impact is “insignificant” or “adverse” for purposes of ESA Section 7 consultation.

Table 3.7-4: Impact Level Definitions for Marine Mammals

Impact Level	Impact Type	Definition
Negligible	Adverse	The impacts on individual marine mammals or their habitat, if any, would be at the lowest levels of detection and barely measurable, with no perceptible consequences to individuals or the population.
	Beneficial	Impacts on species or habitat would be beneficial but so small as to be unmeasurable.
Minor	Adverse	Impacts on individual marine mammals or their habitat would be detectable and measurable; however, they would be of low intensity, short term, and localized. Impacts on individuals or their habitat would not lead to population-level impacts.
	Beneficial	If beneficial impacts occur, they may result in a benefit to some individuals and would be temporary to short term in nature.
Moderate	Adverse	Impacts on individual marine mammals or their habitat would be detectable and measurable; they would be of medium intensity, can be short term or long term, and can be localized or extensive. Impacts on individuals or their habitat could have population-level impacts, but the population can sufficiently recover from the impacts or enough habitat remains functional to maintain the viability of the species both locally and throughout their range.
	Beneficial	Beneficial impacts on species would not result in population-level impacts. Beneficial impacts on habitat may be short term, long term, or permanent but would not result in population-level benefits to species that rely on them.
Major	Adverse	Impacts on individual marine mammals or their habitat would be detectable and measurable; they would be of severe intensity, can be long lasting or permanent, and would be extensive. Impacts on individuals and their habitat would have severe population-level impacts and compromise the viability of the species.
	Beneficial	Beneficial impacts would promote the viability of the affected population or increase population resiliency. Beneficial impacts on habitats would result in population-level benefits to species that rely on them.

3.7.2.1 Impacts of Alternative A – No Action Alternative on Marine Mammals

When analyzing the impacts of Alternative A on marine mammals, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the existing conditions for marine mammals (Table G.1-4 in Appendix G, Impact-Producing Factor Tables and Assessment of Resources with Minor [or Lower] Impacts). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for marine mammals described in Section 3.7.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on marine mammals include pressure from ongoing activities in addition to future non-offshore wind activities, especially vessel traffic and ship strike risk, entanglement with fishing gear, anthropogenic noise, and climate change, as described in Section 3.7.1. The impacts on marine mammals from these ongoing and future non-wind activities will continue and result in similar impacts regardless of offshore wind energy development. The rate and continuation of these events is uncertain, but their impacts on marine mammals would be detectable from changes in various metrics including species abundance, distribution, and habitat use. A summary of ongoing and future non-wind activities and associated IPFs for marine mammals is provided in Table G.1-4 in Appendix G.

If the proposed Project is not approved, impacts from the proposed Project would not occur. Impacts from ongoing, future non-offshore and offshore wind activities would likely still occur (Table G.1-4) resulting in similar impacts on marine mammals, but the exact impact would not be the same due to temporal and geographical differences. Impacts on marine mammals would primarily be driven by vessel traffic and ship strike risk, entanglement with fishing gear, anthropogenic noise, and climate change. For marine mammal species with a PBR approaching zero, such as the NARW, ongoing threats such as vessel strike and fishing gear entanglement can elevate impacts, but the resource would likely recover completely if/when IPF stressors are completely removed.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on marine mammals include continued operation of the Block Island Wind Farm, as well as ongoing construction of Vineyard Wind 1 in OCS-A 0501 and the South Fork Wind Project in OCS-A 0517. Ongoing operation of the Block Island Wind Farm and ongoing construction of Vineyard Wind 1 and South Fork Wind Project, along with planned offshore wind activities, would affect marine mammals through the primary IPFs described below.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than Alternative B). Future offshore wind development activities would affect marine mammals through the following primary IPFs.

Accidental releases: Accidental releases of fuel, oil, and other fluids, hazardous materials, and/or trash and debris may increase as a result of future offshore wind activities. The Vineyard Wind I Final EIS (BOEM 2021b) 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.

Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal impacts on the individual fitness, including adrenal impacts, hematological impacts, liver impacts, lung disease, poor body condition, skin lesions, and several other health impacts attributed to oil exposure (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008; Smith et al. 2017; Sullivan et al. 2019; Takeshita et al. 2017). Additionally, accidental releases may result in impacts on marine mammals due to impacts on prey species. As discussed in Section G.2.2, Water Quality, there would be a low risk of a leak of fuel, fluids, and/or hazardous materials from any single one of the approximately 2,955 WTGs and ESP, each with approximately 5,000 gallons stored. Total fuel, fluids, and/or hazardous materials within the geographic analysis area would be approximately 119 million gallons. According to BOEM’s modeling (Bejarano et al. 2013), a release of 128,000 gallons, which represents all available oils and fluids from 132 WTGs and ESPs, is likely to occur no more often than once per 1,000 years, and a release of 2,000 gallons or less is likely to occur every 5 to 20 years. The likelihood of a spill occurring from multiple WTGs and ESPs at the same time is very low; therefore, the potential impacts from a spill larger than 2,000 gallons are largely discountable. Based on the volumes potentially involved, the likely number 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 (USEPA 2021a). In the unlikely event of a trash or debris release, it would be accidental and localized in the vicinity of the RI/MA Lease Areas. Worldwide, 62 of 123 (about 50 percent) marine mammal species have been documented ingesting marine litter (Werner et al. 2016). The global stranding data indicate potential debris induced mortality rates of 0 to 22 percent. Mortality has been documented in cases of debris interactions, as well as blockage of the digestive track, disease, injury, and malnutrition (Baulch and Perry 2014). However, it is difficult to link physiological impacts on individuals to population-level impacts (Browne et al. 2015). While precautions to prevent accidental releases will be employed by vessels and port operations associated with future offshore wind development, it is likely that some debris could be lost overboard during construction, operations, 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 RI/MA Lease Areas, or the routes traveled by vessels to and from ports.

Anchoring and gear utilization: Ongoing and planned offshore wind activities are likely to include monitoring surveys in the offshore wind lease areas. These could include acoustic, trawl, and trap surveys, as well as other methods of sampling the biota in the area. The presence of monitoring gear could affect marine mammals by entrapment or entanglement; however, it is expected that monitoring plans would have sufficient mitigation procedures in place to reduce potential impacts. Impacts from gear utilization from other offshore wind activities on mysticetes, odontocetes, and pinnipeds are expected to occur at short-term, regular intervals over the lifetime of the projects and have no perceptible consequences to individuals or the population. However, the potential extent and number of animals potentially exposed cannot be determined without proposed Project-specific information.

Cable emplacement and maintenance: Emplacement of submarine cables associated with construction would result in localized disturbance of the seafloor, resulting in the suspension of sediments into the water column with impacts on water quality. The key factors that affect the volume of seabed sediment disturbed and suspended, dispersed in the surrounding sea area, and redeposited on the seabed during cable burial operations include the cable technique being used (i.e., the type of tool selected to bury the cable) and local site conditions, including seabed type and local currents and wave conditions (BERR 2008). The impact on water quality from sediment suspension during cable-laying activities is expected to be temporary and short term.

Under Alternative A, the total area of seafloor disturbed by cable emplacement for offshore wind facilities is estimated to be up to 63,840 acres beginning in 2022 and continuing through 2030 and beyond.

Data are not available regarding marine mammal avoidance of localized turbidity plumes; however, Todd et al. (2015) suggested that since some marine mammals often live in turbid waters and some species of mysticetes employ feeding methods that create sediment plumes, some species of marine mammals have a tolerance for increased turbidity. These species have developed echolocation for communicating, foraging, and navigating by evolving in an environment with variable and predominantly low visibility (Tyack and Miller 2002). Similarly, McConnell et al. (1999) documented movements and foraging of gray 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 gray 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. This suggests that temporary reduction in visibility would not significantly impair behavior and any potential exposures would be localized in extent, limited in magnitude, short term, and unlikely to result in biologically significant impacts.

Turbidity associated with increased sedimentation has some potential to result in temporary and 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 impacts on threatened or endangered marine mammals would be expected (NMFS 2021g). Similarly, the temporary and localized impacts associated with cable emplacement and maintenance are only expected to result in impacts ranging no response to short-term impacts on the behavior of non-threatened and endangered marine mammals. Based on the current anticipated construction schedule provided in Table E-1 in Appendix E, construction impacts associated with multiple projects could overlap in time and space and potentially result in more frequent impacts, though no individual fitness or population-level impacts would be expected. Threatened and endangered marine mammals do not appear to be affected by increased turbidity and would be able to successfully forage in adjacent areas not affected by sediment plumes (NMFS 2021g).

Climate change: Global climate change is an ongoing risk to marine mammals. However, the associated impact mechanisms are complex, not fully understood, often dynamic, and difficult to predict with certainty. Several sub-IPFs related to climate change including increased storm severity and frequency; increased erosion and sediment deposition; increased disease frequency; ocean acidification; and altered habitat, ecology, and migration patterns have the potential to result in impacts on marine mammals. Over time, climate change and coastal development would alter existing habitats, rendering some areas unsuitable for certain species and more suitable for others. For example, the NARW appears to be migrating differently and feeding in different areas in response to changes in prey densities driven in part by climate change (Meyer-Gutbrod et al. 2015, 2021; O’Brien et al. 2022; Reygondeau and Beaugrand 2011). Shifting NARW distribution patterns may result in portions of the population using habitat that is or will become future offshore wind farms on the Atlantic OCS (O’Brien et al. 2022). 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 directly contribute to climate change impacts on marine mammals. Section G.2.1, Air Quality, details the expected contribution of offshore wind activities to climate change.

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 EMF. Depending on the magnitude and persistence of the confounding magnetic field, such an impact could cause a trivial temporary change in swim direction or a longer detour during the animal’s migration (Gill et al. 2005). Such an impact on marine mammals is more likely to occur with direct current cables than with AC cables (Normandeau 2011). Heat transfer into surrounding sediment associated with buried submarine high-voltage cables is possible (Emeana et al. 2016). However, heat transfer is not expected to extend to any appreciable effect into the water column due to the use of thermal shielding, the cable’s burial depth, and additional cable protection such as scour protection or concrete mattresses for cables unable to achieve adequate burial depth. As a result, heat from submarine high-voltage cables is not expected to affect marine mammals. Under Alternative A, at least 6,552 miles of offshore export, inter-array, and inter-link cable would be added in the geographic analysis area based on submitted COPs to date. EMF would be produced 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 and heat resulting from cable operation to low levels (COP Table 4.2-2, Volume III; Epsilon 2022a). 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 be biologically significant.

Noise: There are several intrinsic, extrinsic, and ecological drivers that can result in impacts on individuals and populations of marine mammals. Cetaceans rely heavily on acoustics for communication, foraging, mating, avoiding predators, and navigation (Madsen et al. 2006; Weilgart 2007; Southall et al. 2019, 2021). Offshore wind activities may affect marine mammals if the sound frequencies produced overlap with the functional hearing range of the animal exposed (NSF and USGS 2011). To account for differences in hearing among species, Southall et al. (2007) categorized marine mammals into five generalized hearing groups (low-frequency cetaceans [LFC], mid-frequency cetaceans [MFC], high-frequency cetaceans [HFC], phocid pinnipeds in water [PPW], and otariid pinnipeds in water [OW]), which have been adopted by NMFS (2018) for the purposes of assessing impacts from underwater noise. No species from the OW hearing group (i.e., otariid, or "eared" seals) are expected in the geographic analysis area; therefore, OW species are not discussed further. More recently, Southall et al. (2019) conducted a broad, structured assessment of the audiometric and physiological basis for the categorization of marine mammal hearing groups. Southall et al. (2019) kept the same frequency responses (i.e., hearing sensitivities) but re-categorized the LFC, MFC, and HFC hearing groups to LFC, HFC (previously MFC), and very high-frequency (VHF) (previously HFC) hearing groups, and distinguished between phocid carnivores (i.e., PPW) in water and in air. Their assessment also indicated a probable distinction among baleen whales to include a very-low frequency and an LFC group, as well as an additional distinction among many of the odontocetes to include a distinction between an MFC group containing the beaked, killer, and sperm whales and other HFC cetaceans. There is insufficient evidence to support these distinctions, so the broader LFC and HFC hearing group categories are currently used, resulting in a total of five possible groups. However, Southall et al. (2019) further acknowledge that there are presently insufficient direct data within the HFC and VHF groups to explicitly derive distinct thresholds and weighting functions. They, thus, propose retaining the thresholds and functions adopted by NMFS (2018), but with slightly different categorical identifiers. The results of Southall et al. (2019) remain consistent with the current existing regulatory guidance (NMFS 2018).

A summary of estimated hearing ranges for the remaining marine mammal hearing groups from NMFS (2018) is provided in Table 3.7-5. Sources of anthropogenic noise can generally be categorized in two ways: impulsive noise, which is characterized by an instantaneous and rapid increase in sound pressure over a short period of time; and non-impulsive noise, which does not have the characteristic rapid rise in sound pressure seen in impulsive sources.

Table 3.7-5: Estimated Hearing Ranges for Marine Mammal Hearing Groups

Marine Mammal Hearing Group	Estimated Hearing Range	Representative Species
LFC	7 Hz to 35 kHz	Baleen whales (e.g., fin whale [*Balaenoptera physalus*], sei whale [*Balaenoptera borealis*], NARW [*Eubalaena glacialis*], minke whale [*Balaenoptera acutorostrata*], humpback whale [*Megaptera novaeangliae*])
MFC	150 Hz to 160 kHz	Dolphins (e.g., Atlantic spotted dolphin [*Stenella frontalis*], Atlantic white-sided dolphin [*Lagenorhynchus acutus*], short-beaked common dolphin [*Delphinus delphis*], Risso's dolphin [*Grampus griseus*], common bottlenose dolphin [*Tursiops truncatus*]) and toothed whales (e.g., sperm whale [*Physeter macrocephalus*], long-finned pilot whale [*Globicephala melas*])
HFC	275 Hz to 160 kHz	True porpoises (e.g., harbor porpoise [*Phocoena phocoena*])
PPW	50 Hz to 86 kHz	True seals (e.g., harbor seal [*Phoca vitulina*], gray seal [*Halichoerus grypus*])

Source: NMFS 2018

HFC = high-frequency cetacean; Hz: hertz; kHz: kilohertz; LFC = low-frequency cetacean; MFC = mid-frequency cetacean; NARW = North Atlantic right whale; PPW = phocid pinnipeds in water

Noise can also be characterized as intermittent or continuous depending on how often there are breaks in the generated noise over time. Both types of noise may be produced by activities related to future offshore wind projects. Acoustic thresholds, which represent the minimal sound level at which the onset of a particular impact may occur, are available for both impulsive and non-impulsive noise and each marine mammal hearing group from NMFS (2018), as provided in Table 3.7-6.

Noise-producing activities may affect marine mammals during foraging, orientation, migration, response to predators, social interactions, or other activities (Southall et al. 2007, 2019). Noise exposure can interfere with these functions, with the potential to cause responses ranging from mild behavioral changes and temporary hearing impairment (TTS) to auditory injury such as permanent threshold shift (PTS) (Southall et al. 2019). The type of impact would depend on the type of noise, the SPL to which an animal is exposed, and the duration of the exposure. Since the potential impacts of noise on marine mammal species potentially present in the geographic analysis area involves a complex analysis of the manner in which sound interacts with the physiology of marine mammals and the potential responses of those animals to sound,[17] only general information about sound and marine mammal hearing, along with potential impacts of sound on marine mammals, is provided in this section. A summary of pile-driving noise exposure estimates is provided in Appendix B. These exposure estimates, in addition to the other acoustic impacts described below, may result in noise impacts on marine mammals. Understanding the existing acoustic habitat and autecological characteristics of marine mammals described in this section, in addition to the calculated exposure estimates, were essential to the consideration of pile-driving impacts on marine mammals. Exposure estimates are provided in Appendix B and described in more detail in COP Appendix III-M (Epsilon 2022a), as well as the NMFS proposed Letter of Authorization (LOA) Fed. Reg. notice planned to be issued under the MMPA.

Table 3.7-6: Acoustic Thresholds[a] for Marine Mammal Hearing Groups

Marine Mammal Hearing Group	Impulsive Noise Sources		Non-Impulsive Noise Sources	
	PTS	Behavioral Disturbance (SPL)	PTS (SEL$_{24h}$)	Behavioral Disturbance
LFC	SEL$_{24h}$: 183 dB re 1 µPa^{2} s Lpk: 219 dB re 1 µPa	160 dB re 1 µPa	199 dB re 1 µPa^{2} s	Intermittent sources: SPL 160 dB re 1 µPa Continuos sources: SPL 120 dB re 1 µPa
MFC	SEL$_{24h}$: 185 dB re 1 µPa^{2} s Lpk: 230 dB re 1 µPa	160 dB re 1 µPa	198 dB re 1 µPa^{2} s	Intermittent sources: SPL 160 dB re 1 µPa Continuos sources: SPL 120 dB re 1 µPa
HFC	SEL$_{24h}$: 155 dB re 1 µPa^{2} s Lpk: 202 dB re 1 µPa	160 dB re 1 µPa	173 dB re 1 µPa^{2} s	Intermittent sources: SPL 160 dB re 1 µPa Continuos sources: SPL 120 dB re 1 µPa
PPW	SEL$_{24h}$: 185 dB re 1 µPa^{2} s Lpk: 218 dB re 1 µPa	160 dB re 1 µPa	201 dB re 1 µPa^{2} s	Intermittent sources: SPL 160 dB re 1 µPa Continuos sources: SPL 120 dB re 1 µPa

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[17] For example, predicting how many marine mammals could be harassed required potential impacts to be evaluated within the context of applicable laws and regulations. Both the MMPA and ESA require all anticipated responses to sound resulting from the proposed Project be considered relative to their potential impact on animal growth, survivability, and reproduction. Although a variety of impacts may result from an acoustic exposure, not all impacts would affect survivability or reproduction (e.g., short-term changes in respiration rate would have no effect on survivability or reproduction).

Source: NMFS 2018; 70 Fed. Reg. 7 (January 11, 2005)

dB re 1 µPa^2 s = decibels referenced to 1 micropascal squared second; dB re 1 µPa = decibels referenced to 1 micropascal; HFC = high-frequency cetaceans; LFC = low-frequency cetacean; MFC = mid-frequency cetacean; Lpk = peak sound pressure; PTS = permanent threshold shift; PPW = phocid pinnipeds in water; SEL_{24h} = sound exposure level over 24 hours; SPL = sound pressure level

[a] SEL_{24h} thresholds are frequency weighted based on the marine mammal hearing group, while the Lpk and SPL thresholds are not frequency weighted.

Overview of Sound and Marine Mammal Hearing

Sound travels in waves, the basic metrics of which are frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in cycles per second or hertz (Hz). Wavelength is the distance in space between corresponding points (e.g., peak or tough) of a sound wave, the physical length of one cycle, and is measured in distance units such as meters or feet. Higher frequency sounds have shorter wavelengths than lower frequency sounds and typically attenuate (get quieter) more rapidly, except in certain cases such as shallower water. Amplitude is the peak sound pressure (Lpk) of the sound wave, or the “loudness” of a sound and is usually measured in units of pressure (µPa) but is typically described using dB re 1 µPa. When underwater objects vibrate or activity occurs, sound waves are created. These waves alternately compress and decompress the water as the sound wave travels. The physical manifestation of these propagating sound waves are the changes in pressure and the motion of the particles, leading to that pressure change. Pressure can be characterized as the compression and rarefaction of the water as the sound wave propagates through it. Particle motion is the displacement, or back and forth motion, of the water molecules that create the compression and rarefaction. Both factors contribute to how marine life detect underwater noise and the potential for impacts on these species. However, marine *mammal* hearing is based on the detection of sound pressure, and there is no evidence to suggest cetaceans can detect particle motion for the purposes of hearing and noise detection (Nedelec et al. 2016).

Marine mammals use sound for communication, individual recognition, predator avoidance, prey capture, orientation, navigation, mate selection, and mother-offspring bonding. Thus, the surrounding acoustic habitat, or soundscape, is a key component of suitable marine mammal habitat (Clark et al. 2009). The term acoustic habitat is defined here as the environment within which an animal perceives and transmits acoustic cues important for foraging, reproduction, socialization, and predator avoidance. The acoustic habitat is made up of concomitant sounds that create regional background, or ambient, acoustic conditions (DOSITS 2021) through which discrete signals must be sent and gathered by animals adapted to living in these acoustically defined habitats. Underwater ambient sound sources are categorized as either natural, due to either biological or physical processes, or anthropogenic (i.e., human-made). Biological sources describe sounds created by marine life (e.g., marine mammals, fish, snapping shrimp). Physical sources characterize the various oceanographic and geological processes, including wind and wave activity, rain, cracking sea ice, undersea earthquakes, and volcano eruptions. Sources of anthropogenic sound include shipping and other vessel traffic, military activity, marine construction, oil and gas exploration, and offshore energy development.

The contribution of any individual sound source (either natural or anthropogenic) to the acoustic habitat will vary by location, time, and the other contributing sound sources. The sound levels and frequencies received by marine animals from the variety of sound sources depends on the characteristics of the source as well as the local physical and environmental conditions. Factors such as temperature, salinity, pressure, bathymetric characteristics, and sediment properties also influence sound propagation, and thus the acoustic habitat, within a given location (Hovem 2007; Bradley and Stern 2008).

Assessing impacts of noise sources must consider ambient conditions to understand how potential increases in SPLs or increases in specific frequency spectra might influence marine mammals’ use and perception of their acoustic habitats. Ambient noise levels can be expected to vary widely over both coarse and fine spatial and temporal scales. Sound levels at a given frequency and location can vary by 10 to 20 dB from day to day (Richardson et al. 1995). The result is that, depending on the source type and its intensity, sound from a specified activity may be a negligible addition to the local acoustic habitat or could form a distinctive signal that may affect marine mammals.

The dominant cause of naturally occurring noise in the ocean is physical processes occurring at or near the ocean surface in the form of wind and wave activity (Wenz 1962; Erbe 2011; Harding and Cousins 2022). Noise produced by wind and waves are generally correlated with one another and fall within the 100 Hz to 10 kilohertz (kHz) frequency band (Wenz 1962; Urick 1984; Erbe 2011). Ambient noise in very shallow environments (<151 feet) can be largely driven by wind speed at lower frequencies from 1 to 100 Hz (Wenz 1962; Erbe 2011). Rain can increase natural ambient noise levels by up to 35 dB across a broad range of frequencies from several hundred Hz to more than 20 kHz (NRC 2003; Richardson et al. 1995). Heavy precipitation associated with large storms can generate noise at frequencies as low as 100 Hz and can significantly affect ambient noise levels at considerable distances from the storm’s center (NRC 2003; Duarte et al. 2021). In deep-water environments (i.e., water depths beyond the OCS slope), prevailing low-frequency ambient sound at frequencies from 1 to 10 Hz is mainly the result of geologic events, turbulent pressure fluctuations, and pressure effects from surface waves (Wenz 1962; Erbe 2011).

Marine mammals can contribute significantly to ambient sound levels, as can some fish and snapping shrimp, particularly on regional and local scales (NRC 2003; Richardson et al. 1995). Most biological sources have frequency spectra from approximately 10 Hz to over 100 kHz (Wenz 1962; Erbe 2011).

Historically, the physical and biological sound sources were the primary contributors to the ocean’s soundscape; however, over the last century, anthropogenic sources have become the dominant noise sources in some areas (Miksis-Olds and Nichols 2016; Haver et al. 2020; Sertlek 2019) Heavy vessel traffic can dominate the ambient acoustic habitat at frequencies between 10 and 500 Hz (Wenz 1962; Erbe 2011). In the OECC and SWDA, existing anthropogenic sources include shipping and other vessel traffic, pile driving for various activities, geophysical surveys for site investigations, and military activity. These sources produce noise within frequency bands ranging from 10 Hz to 10 kHz (Wenz 1962; Erbe 2011).

Current data indicate not all marine mammal species have equal hearing capabilities (e.g., Richardson et al. 1995; Wartzok and Ketten 1999; Au and Hastings 2008; Southall et al. 2019). To account for this, Southall et al. (2007, 2019) recommended that marine mammals be divided into the functional hearing groups discussed previously and provided in Table 3.7-5. These hearing groups were defined using directly measured or estimated hearing ranges from available behavioral response data, audiograms derived using auditory evoked potential (AEP), anatomical modeling, and other available data. No direct measurements of hearing ability have been successfully completed for mysticetes (i.e., LFC), therefore, the estimated hearing range is instead based on their vocalization frequencies, anatomical modeling, anecdotal observations of responses to signals in free-ranging individuals, and physiological differences between mysticetes and other cetacean species (Southall et al. 2019). Generalized hearing ranges were chosen based on the approximately 65 dB threshold from the normalized composite audiograms, with the exception of lower limits for LFC where the lower bound was deemed biologically implausible and the lower bound from Southall et al. (2007) was retained. Marine mammal hearing groups and their associated hearing ranges for those species that are likely to occur in the geographic analysis area are depicted in Table 3.7-5.

Overview of Potential Impacts of Noise on Marine Mammals

Anthropogenic noise covers a broad range of frequencies and sound levels, which can have a range of impacts on marine mammals, varying from none or minor to potentially severe responses depending on received levels, the duration of the exposure, behavioral context, and various other factors (Southall et al. 2019, 2021). The degree of impact is intrinsically related to the signal characteristics, received level, distance from the source, and duration of the sound exposure. Specific manifestations of acoustic impacts on marine mammals are summarized in this subsection followed by a discussion of potential impacts that may result from noise-producing future offshore wind activities without the proposed Project. This discussion reviews several publications concerning studies of behavioral effects, masking, and physiological effects available through the present data, references for which are provided in the bullets for each impact type category below. For the purposes of this analysis, the impacts on marine mammals from anthropogenic sound were assessed based on the general category of impact and by the exposure estimates summarized in Appendix F, Analysis of Incomplete and Unavailable Information and Other Required Analyses, and the COP Appendix III-M (COP Appendix III-M; Epsilon 2022a). The categorical impact types are as follows:

- Behavioral impacts: Behavioral responses to noise can cause subtle to extreme changes in normal behavior, with some behavioral responses resulting in biologically relevant consequences. Behavioral responses including startle, avoidance (i.e., changes in swim speed and direction), displacement, diving, and vocalization alterations have been observed in mysticetes, odontocetes, and pinnipeds. In some cases, these have occurred at ranges of tens to hundreds of kilometers from the sound source (Gordon et al. 2004; Tyack 2008; Miller et al. 2014). However, behavioral observations are variable, some findings contradictory, and the biological significance of the effects not fully quantified (Gordon et al. 2004; Southall et al. 2021). Behavioral reactions of marine mammals to noise are difficult to predict because reactions depend on numerous factors including the species being evaluated; the animal's state of maturity, prior experience with or exposure to anthropogenic noises, current activity patterns, and reproductive state; time of day; and weather state (Wartzok et al. 2004; Southall et al. 2021). There is also potential for differences among individuals of the same species (Castellote et al. 2014). If a marine mammal reacts to underwater noise by changing its behavior or moving to avoid the sound, the impacts of that change may not be important to the individual, the stock, or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area, impacts on individuals and the population could be significant. For marine mammals, assessing the severity of behavioral effects associated with anthropogenic noise exposure presents unique challenges due to the inherent complexity of behavioral responses and the contextual factors affecting them, both within and between individuals and species. Severity of responses can vary depending on characteristics of the noise source including whether it is moving or stationary, the number and spatial distribution of noise source(s), its similarity to predator sounds, and other relevant factors (Richardson et al. 1995; NRC 2005; Bejder et al. 2009; Barber et al. 2010; Ellison et al. 2012; Southall et al. 2007, 2019, 2021).
- Masking: Masking occurs where there is a reduction in the detectability of a sound signal of interest (e.g., communication calls, echolocation) due to the presence of another sound, generally for sounds with similar frequencies. Under normal circumstances, in the absence of high background noise levels, an animal would hear a sound signal that is above its absolute hearing threshold. Masking prevents part or all of a sound signal from being heard and decreases the distances that underwater sound can be detected by marine animal. These impacts could cause a long-term decrease in a marine mammal's efficiency at foraging, navigating, or communicating due to a reduction in communication space and inability to detect prey or threats acoustically (ICES 2005; Clark et al. 2009; Erbe et al. 2018). For some types of marine mammals, specifically odontocete species that use echolocation for hunting prey, empirical evidence confirms that the degree of masking depends strongly on the relative directions at which noise arrives and the characteristics of the masking sound (Penner et al. 1986; Dubrovskiy 1990; Bain et al. 1993; Bain and Dahlheim 1994; Branstetter et al. 2021; von Benda-Beckmann et al. 2021).
- Auditory impacts: Based on existing studies, the physiological auditory impacts of noise on animals can include temporary or permanent hearing loss, physiological responses resulting from changes in normal diving behaviors, and hormonal stress responses (NMFS 2018). In general, marine mammals exposed to

high-intensity sound or to lower intensity sound for prolonged periods can experience hearing threshold shifts or the loss of hearing sensitivities at certain frequencies (Nowacek et al. 2007; Finneran 2015; Southall et al. 2019). Where the loss of hearing sensitivity is not fully recoverable, this would be considered a PTS, and where an individual's hearing threshold can recover with time, this is considered a temporary threshold shift (TTS) (Southall et al. 2007). PTS results in a permanent elevation in the minimum hearing threshold and, therefore, permanent loss of hearing, which is considered an auditory injury. PTS is attributed to exposure to very high Lpk, or prolonged or repeated exposures to a strong enough sound over a 24-hour period (i.e., high sound exposure level [SEL_{24h}]). Permanent damage to parts of the inner ear, such as the sensory hair cells in the cochlea, is associated with sound-induced PTS. TTS, also known as auditory fatigue, is the milder form of hearing impairment that is non-permanent and results from exposure to shorter duration and/or lower intensity sounds than those that elicit PTS. Both conditions are species-specific and lead to an elevation in the minimum hearing threshold. TTS can last for minutes, hours, or days depending on the level (frequency and intensity), energy distribution, and duration of the noise exposure, among other considerations. For summaries of data on TTS in marine mammals or for further discussion of TTS onset thresholds, see Southall et al. (2007, 2019), Finneran and Jenkins (2012), Finneran (2015), and 81 Fed. Reg. 66461 (September 27, 2016). Stress responses are typically physiological changes in a marine mammal's blood chemistry, while behavioral responses involve changes in a marine animal's normal actions. Stress responses due to exposure to anthropogenic sounds or other stressors and their impacts on marine mammals have been reviewed (e.g., Fair and Becker 2000; Romano et al. 2002a; Chen et al. 2018b; Yang et al. 2021) and, more rarely, studied in wild populations (e.g., Romano et al. 2002b). For example, Rolland et al. (2012) found that a 6 dB noise reduction from decreased ship traffic in the Bay of Fundy following the attacks of September 11, 2001, was associated with decreased stress in NARWs. These and other studies lead to a reasonable expectation that some marine mammals will experience physiological stress responses on exposure to acoustic stressors, and it is possible that some of these would be classified as "distress." In addition, any animal experiencing TTS would likely also experience stress responses (NRC 2005).

- Non-auditory impacts: Non-auditory impacts (sometimes referred to as barotrauma) results from rapid and instantaneous changes in the ambient pressure level in the water and subsequently within the fluids and tissue of an animal, causing physical injury to soft tissue and organs. This form of non-auditory, physiological injury can occur in marine mammals exposed to rapid pressure changes that can theoretically occur close to an explosive source such as potential UXO detonations. Non-auditory impacts during UXO detonations would result from compression of a body exposed to the blast wave and is usually observed as trauma to gas-filled structures such as the lung or gut (U.S. Navy 2017). Large, rapid pressure changes at the tissue-air interfaces in these organs may cause tissue rupture and a range of impacts depending on the severity of the exposure (U.S. Navy 2017).

The noise produced by most offshore wind construction and operations has the potential to result in one or more impacts within the categories described above. Noise is characterized as an extrinsic stressor, defined by NASEM (2017) as "…a factor in an animal's external environment that creates stress." Anthropogenic noise on the OCS associated with the future offshore wind development, including noise from project-related impact pile driving, vibratory pile driving, aircraft, G&G surveys, operational WTGs, and vessel traffic, has the potential to result in impacts on marine mammal foraging, orientation, migration, predator detection, social interactions, or other activities (Southall et al. 2007, 2019, 2021).

Impact Pile Driving

An impulsive noise source associated with offshore wind development projects will result from impact pile driving of foundations during construction. The following analysis assesses the impacts of pile-driving activities associated with other future offshore wind projects. Impact pile driving has a higher risk of acoustic impact on marine mammals due to the relatively high source levels associated with this activity which produces high noise levels in both the surrounding underwater environment and surrounding air. Noise levels vary depending on the size of the hammer, diameter of the pile, properties of the seabed, and other environmental factors (Amaral et al. 2018, 2020; Bellmann et al. 2020; JDN 2020). 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. Construction of offshore wind facilities is expected to occur intermittently from 2022 to 2030 and beyond in lease areas that are anticipated to be developed on the Atlantic OCS. Construction of 2,995 offshore structures would result in temporary increases in noise that may affect 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 noise would be variable. An individual may be exposed to 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 impacts of exposure to pile-driving noise range from minor and temporary behavioral disturbance to auditory injury.

All offshore wind projects are expected to implement mitigation similar to that outlined in the COP (Volume III, Section 6.7.4, Table 6.7-20; Epsilon 2022a), which would reduce the risk of long-lasting impacts, such as PTS. Mitigation and monitoring measures applied to offshore wind construction may include use of noise attenuation systems (e.g., bubble curtains), which effectively put up a physical barrier around the pile being installed to reduce the noise level propagated from the impact hammering; soft starts such that the impact hammer would begin using the lowest possible energy and slowly increase its power until it reaches the maximum to give animals a chance to leave the area; and monitoring the ensonified area for the presence of marine mammal species to stop piling if an animal is within a designated distance. Even with mitigation, some marine mammals may experience PTS; however, no injury from pile driving has been documented for any marine mammal species, and mitigation would likely reduce the risk of any population-level impacts (Stöber and Thomsen 2019; Harding and Cousins 2022). The probability and extent of potential impacts are situational and 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, which is typically conducted for each project’s COP.

Noise impacts on marine mammals arising from pile-driving activities could occur under three different scenarios that would affect the duration and frequency of exposure to pile-driving noise:

- Concurrent pile driving associated with neighboring projects (i.e., piles being driven at multiple projects on the same day within the same geographic regions of Massachusetts/Rhode Island, New York/New Jersey, Delaware/Maryland, or Virginia/North Carolina);
- Non-concurrent pile driving in the same year (i.e., piles being driven at multiple projects within the same year but not on the same day); and
- Consecutive, multi-year pile driving (concurrent or non-concurrent).

Concurrent pile driving at neighboring projects is anticipated under Alternative A. 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 a broader area but decreases the total number of days of potential exposure from each project in the same area. Concurrent pile driving occurring within the same 24-hour period may create a greater overall impact area(s) among neighboring projects in which marine mammals could be exposed to noise that may cause auditory 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 per project installed per day results in the maximum-case scenario for the greatest number of overlapping pile-driving days for neighboring projects. The RI/MA Lease Areas have the greatest potential for concurrent pile driving due to the number of projects that may have construction schedules overlapping with one another. The total number of possible concurrent construction days, the remaining number of pile driving days required to complete construction of proposed projects, and the total pile driving days in a given year are provided in Table 3.7-7 for each geographic region. This is a conservative estimate that reflects the maximum-case scenarios identified in PDEs and may overestimate the actual number of foundations installed for each project and consequently overestimate the number of concurrent pile-driving days. Marine mammals present in these areas could be exposed to the noise from more than one pile-driving event per day, repeated over a period of days, dependent on the movement patterns of that animal. It is unlikely that individual marine mammals would be exposed to pile-driving noise generated on the same day from non-neighboring projects because of the distances between such projects and considering the distance and speed at which an individual would be expected to travel over the course of a day.

Table 3.7-7: Concurrent and Non-Concurrent Impact Hammer Pile-Driving Days

Geographic Region	2022	2023	2024	2025	2026	2027	2028	2029
Maine[a]								
Multiple projects[b]	0	0	0	0	0	0	0	0
Single project[c]	0	2 (1)	0	0	0	0	0	0
Total pile-driving days[d]	0	2 (1)	0	0	0	0	0	0
RI/MA Lease Areas[a]								
Multiple projects[b]	0	102 (51)	0	149 (75)	0	0	0	0
Single project[c]	63 (32)	21 (11)	68 (34)0	16 (8)	0	0	0	0
Total pile-driving days[d]	63 (32)	123 (62)	68 (34)	165 (83)	0	0	0	0
New York/New Jersey Lease Areas								
Multiple projects[b]	0	101 (51)	72 (36)	0	113 (57)	0	0	82 (41)
Single project[c]	0	3 (2)	38 (19)	100 (50)	46 (23)	0	0	36 (18)
Total pile-driving days[d]	0	104 (52)	110 (55)	100 (50)	159 (80)	0	0	118 (59)
Delaware/Maryland Lease Areas								
Multiple projects[b]	0	0	17 (9)	0	0	0	0	0
Single project[c]	0	0	108 (54)	93 (47)	100 (50)	0	0	0
Total pile driving-days[d]	0	0	125 (63)	93 (47)	100 (50)	0	0	0
Virginia/North Carolina Lease Areas								
Multiple projects[b]	0	0	0	0	0	0	0	80 (40)
Single project[c]	0	208 (104)	0	70	0	0	0	43 (22)
Total pile driving-days[d]	0	208	0	70	0	0	0	123

RI/MA Lease Areas = Rhode Island and Massachusetts Lease Areas

[a] The number of pile driving days is provided for the pile driving scenarios: one pile per day (two piles per day).

[b] This number represents the maximum number of days that two or more concurrent projects could be pile driving within the geographic region. Additional information regarding the total number of concurrent projects within a given year are provided in Table E-1 in Appendix E.

[c] This number represents the maximum number of days that one project could be pile driving to complete construction within a given year.

[d] This number represents the total number of days that pile driving (concurrent and non-concurrent) could occur within the geographic region within a given year.

Non-concurrent pile driving in the same year could result in the exposure of marine mammals to pile-driving noise on multiple days in the same year depending on seasonal migratory behaviors, home ranges, and other factors. This exposure could occur periodically in different geographic areas over the course of the year. Non-concurrent pile driving potentially decreases the daily amount of noise exposure in a geographic area from neighboring projects but increases the total number of days of pile driving in the same area. A pile-driving scenario with construction occurring on different days would result in the greatest number of days that an individual could be exposed to pile-driving noise. If construction of other offshore wind projects is timed to not overlap and occurs on separate days, the number of non-concurrent pile-driving days in any given year is greater than the concurrent pile-driving scenario.

Impact pile driving for planned offshore wind projects under Alternative A is anticipated over multiple years (2022 to 2030 and beyond). Overall, a total of 3,166 or 1,522 non-concurrent pile-driving days under the one-pile-per-day or two-piles-per-day scenarios, respectively, may occur over this period under the maximum-case scenario, where an individual marine mammal could be exposed to pile driving in each geographic region. Marine mammals could be intermittently exposed to pile-driving noise throughout this period, from one or more projects, with additional potential exposure from 2029 and beyond.

Marine Mammal Responses to Pile Driving

The population consequences of disturbance have gained recent attention in marine mammals, and most models have focused on odontocetes (Booth et al. 2014; Farmer et al. 2018a, 2018b; King et al. 2015; Natural England 2017; Pirotta et al. 2015; NASEM 2017) 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. 2016; Villegas-Amtmann et al. 2015). Not all 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.

Harbor porpoises have received particular attention in European waters due to their protection under the European Union Habitats Directive (IAMMWG et al. 2015) and the threats they face because of fisheries bycatch. A study on the first German offshore wind farm showed that fewer porpoises were detected up to 12 miles (19 kilometers) from the pile-driving site and that the duration of the displacement period (up to 6 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 impacts showed that out to 3.1 miles (4.9 kilometers), porpoise detections declined by about 68 percent; at 6.2 to 9.3 miles (9.9 to 14.9 kilometers), detections declined by about 26 percent, with no clear reduction in porpoise detections beyond 10.6 to 12.4 miles (17.1 to 19.5 kilometers). Porpoise detections increased 12 hours after pile driving at 12.4 miles (19.5 kilometers) and increased 20 to 31 hours after pile driving at closer distances up to 1.2 miles (1.9 kilometers). Little to no habituation was found, and there was no indication for the presence of temporal overall impacts from construction of the eight wind facilities (Brandt et al. 2016). Scheidat et al. (2011) studied the impact on harbor porpoises over several years 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 impact 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. 2011; 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 (24.9 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 (39.9 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 impacts depending on duration and intensity of exposure, as well as species and behavior of the animal (e.g., migrating, foraging). Many animals would avoid areas with increased sound levels; however, if an animal does not leave the area, injury may occur.

Taken as a whole, the available literature suggests avoidance of pile driving by seals and HFCs 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. There is no evidence that mysticete species avoid pile-driving events. However, pile driving would 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, mitigation and monitoring measures would be implemented, which would reduce the severity of impacts on individuals, which reduces the potential for impacts on populations.

For the projects considered under Alternative A, 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 to the energy resources used for avoidance and any energetic costs of lost foraging opportunities. 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.

There is the possibility that construction and impact pile-driving activities associated with other offshore wind development may overlap (Table 3.7-7). While there is little potential for overlapping areas ensonified above relevant thresholds, underwater noise from multiple projects could intermittently be heard by animals traveling through the area. Given the short duration of any particular pile-driving event, the size of the area surrounding each pile where potentially disturbing levels of noise would be experienced, the unlikely scenario that impact pile driving would be occurring at the exact same time, and the inclusion of mitigation and monitoring measures designed to minimize exposure of marine mammals generally (and NARW specifically) to pile-driving noise, consideration of multiple pile-driving events in the same year does not change the conclusions reached.

BOEM estimates that pile driving could be expected between 2 to 6 hours per day (two foundations per day) for each project, resulting in up to 12 hours per day if conducted independently and up to 6 hours per day if conducted simultaneously. Therefore, it is anticipated that there would be a 9.5- to 12-hour window each day over which pile-driving activities could occur between May 1 and December 31. The foraging potential of an individual marine mammal may be decreased during exposure to pile-driving noise. However, actual lost foraging potential is dependent on the behavior of the animal at the time of exposure (e.g., resting, socializing, foraging, etc.), the availability and quality of the forage in a particular area, the duration of the disturbance, and ability to resume foraging in the area where an animal was displaced. Given the anticipated distribution and movement patterns of individual whales over the period of time that pile driving is anticipated, the same individual whales are not expected to be disturbed over the entire duration of pile-driving activities.

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 designed to avoid exposure of individuals to injurious levels of noise and minimize and monitor impacts that would result in behavioral responses. The available literature suggests that individual marine mammals would 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 likely context-dependent. The potential for biologically significant responses is expected to increase with increased exposure to multiple pile-driving events.

Vibratory Pile Driving

Vibratory pile-driving used during export cable and port facility construction or setting WTG and ESP pile prior to impact pile driving may produce noise that exceeds the continuous noise threshold of 120 dB re 1 µPa (Table 3.7-3) hundreds of feet from the source (Illingworth and Rodkin 2017), but these events are expected to be short term, which limits the marine mammals potentially present during construction. While behavioral responses may occur from vibratory pile driving, they are not expected to be long lasting or biologically significant to marine mammal populations.

Drilling

Drilling activities prior to pile-driving activities remove soil and/or boulders from inside the piles in cases of pile refusal. Drilling may produce SPL of 140 dB re µPa at 3,280 feet (Austin et al. 2018). This would exceed the continuous noise threshold of 120 dB re 1 µPa (Table 3.7-3) beyond 3,000 feet, but these events are expected to be short term, which limits the number of marine mammals potentially present during construction. While drilling may cause behavioral responses, these responses are not expected to be long lasting or biologically significant to marine mammal populations.

Unexploded Ordnance Detonations

There are several options for UXO removal that include stabilizing the UXO for safe relocation without detonation, low-order detonation designed to reduce the net explosive yield of a UXO compared to conventional “blow-in-place” techniques, and high-order detonation in which the full explosive weight is detonated in the place where the object is found. The appropriate method of removal for each project would depend on the condition of the UXO (i.e., how stable it is for potential relocation)—if any UXO are discovered—and surrounding environmental conditions. With any detonation of explosives, there is the risk of mortality, non-auditory injury, auditory injury, and behavioral modification in the form of a TTS and brief disturbance of behavior to marine mammals. Potential impacts from in situ UXO detonation would result from both low- and high-order detonation methods, with less intense pressures and noise produced from the low-order detonations. Although low-order detonation methods would generally be preferred, these methods may not always fully eliminate the risk of high-order detonation. As a result, potential impacts from in situ UXO disposal need to be assessed assuming high-order detonations would occur. Noise generated during detonation is dependent on the size and type of UXO, amount of charge used, location, water depth, soil conditions, and burial depth of the UXO.

Aircraft

Future offshore wind development may include the use of small, fixed wing aircraft for biological surveys and helicopters to supplement crew transport during construction and operations. Helicopters transiting to offshore wind development areas 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. 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 whale is located within 820 to 1,181 feet of the helicopter, it is possible that behavior responses may occur (Patenaude et al. 2002), but they are expected to be temporary and short term. NARW approach regulations (50 CFR § 222.32) prohibit approaches within 1,500 feet. BOEM would 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 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).

Geological and Geophysical Surveys

Both impulsive and non-impulsive noise may be produced by G&G survey activities used in pre-, during-, and post-construction site characterization surveys. Some G&G survey equipment (e.g., boomers, sparkers) can produce high-intensity impulsive noise, while other survey equipment (e.g., compressed high-intensity radiated pulse sonar) produce lower intensity noise without the characteristic rise in pressure (Crocker and Frantantonio 2016; Crocker et al. 2019). Noise resulting from offshore wind site characterization surveys is of less intensity and affects a smaller area than the acoustic energy characterized by seismic air guns typically associated with oil and gas exploration. While seismic air guns 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 implement mitigation and monitoring measures designed to minimize any potential impacts on marine mammals from exposure to active acoustic sources. BOEM requires these measures through lease stipulations and prescribed by NMFS in its ITA pursuant to Section 101(a)(5) of the MMPA. Similarly, the requirement to comply with mitigation and monitoring measures for these surveys would reduce any impacts on individuals that could affect threatened and endangered populations listed under the ESA. These measures may include, but are not limited to, seasonal restrictions, protected species observers (PSO), passive acoustic monitoring (PAM), pre-survey monitoring, and the establishment of exclusion zones in which sound sources would be shut down when marine mammals are present. All types of G&G survey equipment have the potential to result in short-term behavioral responses, but no auditory injury or long-lasting impacts on marine mammals are expected from G&G surveys (COP Appendix I-H; Epsilon 2022a).

Operational Wind Turbine Generators

Marine mammals would be able to hear the continuous underwater noise of operational WTGs. Recordings have been made of operational WTGs producing low-frequency (<500 Hz) noise with broadband SPLs ranging from 92 to 137 dB re 1 µPa at distances of 65 to 656 feet from the source (Tougaard et al. 2020). SPLs produced by operational WTGs vary based on the WTG type, wind speed, and location, with data showing an increase in SPLs with increasing WTG size and wind speed. Because the proposed Project WTGs are larger than those previously measured, operational noise could be higher than the smaller WTG measured and would exceed ambient noise levels at greater distances from the source. However, the analyses conducted by Tougaard et al. (2020) showed that sound levels produced by individual WTG were comparable to or lower than sound levels within 0.6 mile of commercial vessel noise. Additionally, data analyzed by Stöber and Thomsen (2021) indicate that the type of WTG influences the noise levels produced, as measurements of WTG using gear boxes were higher than those using direct drive technology, which is proposed for this Project. Studies also suggest marine mammal species may use the wind farm for foraging following prey species that are attracted to the foundations (Scheidat et al. 2011; Russell et al. 2014); thus, marine mammals in the SWDA are not expected to avoid the area throughout the operational life of the proposed Project. As such, little to no impacts on individual marine mammals would be expected.

Vessel Traffic

Vessel noise is the human activity that generates the greatest amount of sound energy into the ocean (Weilgart 2007). Vessel noise may result in multiple impacts for marine mammals, including reduced communication, interference with predator/prey detection, and avoidance of habitat areas (Southall 2007). Ship engines and vessel hulls themselves emit broadband, continuous sound, generally ranging from 150 to 180 dB re 1 µPa per meter, at frequencies below 1,000 Hz (NSF and USGS 2011). The frequency range for vessel noise falls within marine mammals' known range of hearing and would be audible. While vessel noise may have some impact on marine mammal behavior, it would be limited to temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes (Erbe et al. 2018, 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. Jensen et al. 2009 indicate that small vessels at a speed of 5 knots in shallow coastal water can reduce the communication range for common bottlenose dolphins within 164 feet of the vessel by 26 percent. 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 generally propagate farther from the sound source compared to higher frequencies, LFC 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 22 and a maximum of 56 vessels operating in the geographic analysis area for marine mammals at any given time, although actual vessel trips would vary based on individual project designs and port locations. This increase in vessel traffic and associated noise impacts would be at its peak in 2026, when at least 16 offshore wind projects (not including Alternative B) would be under simultaneous construction along the U.S. East Coast—i.e., a total of approximately 352 to 896 vessels in the geographic analysis area at any given time during peak construction.[18] 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 brief behavioral responses that would be expected to dissipate once the vessel or the individual has left the area. These short-term and temporary responses are unlikely to be significant as no physiological impacts or long-term avoidance of important habitat is expected (BOEM 2013; McPherson et al. 2016). These brief responses of individuals to passing vessels would be infrequent given the patchy distribution of marine mammals and that no stock or population-level impacts would be expected.

Noise associated with cable laying would be produced during route identification, trenching, jet plow embedment, backfilling, and cable protection installation by vessels and equipment, with intensity and propagation dependent on 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 around the source (Bald et al. 2015; Nedwell and Howell 2004; Taormina et al. 2018). However, animals are less likely to respond to sound levels when distant from a source, even when those levels elicit responses at closer ranges; both proximity and received levels are important factors in aversion responses (Dunlop et al. 2017). While cable-laying activities may produce noise that exceeds the behavioral thresholds for marine mammals (Table 3.7-6), exposure to noise at or above a specified threshold level does not necessarily equate to a behavioral response or a biological consequence.

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[18] As specified in Section 1.2, Purpose of and Need for the Proposed Action, BOEM's analysis of Alternative A assumes that the potential challenges of vessel availability and supply chain will be overcome, and projects will advance as specified in the scenario.

Summary of Noise Impacts

When all of the acoustic stressors described above are assessed, they are all likely to contribute to underwater sound levels that could cause behavioral harassment, temporary auditory impairment (TTS), or (in worst cases) auditory injury (PTS) to some 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. 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 offshore wind development, in particular distant shipping noise, which is more widespread and continuous. It is not known whether the co-occurrence of shipping noise, G&G surveys associated with renewable energy site characterization, military training, and sounds associated with pile driving and other proposed activities would result in harmful additive impacts on marine mammals. However, these activities are widely dispersed, the sound sources are intermittent, and mitigation and monitoring measures would be implemented to reduce acoustic disturbance from pile driving to reduce any potential combined exposure to elevated underwater sound levels of concern. The temporary impacts on LFC that would result from the pile driving of offshore wind projects would be added to existing noise levels beginning in 2022 and continuing through 2030 and beyond along the U.S. East Coast. The IPF would 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 impacts of PTS may be permanent.

Port utilization: Global shipping traffic increased fourfold between 1992 and 2012 (Tournadre 2014). Growth worldwide is expected to continue, including on the U.S. OCS. Increases in global shipping traffic and expected increases in port activity along the U.S. East Coast from Maine to Virginia would 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 (Elkinton et al. 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 localized to nearshore habitats. Future offshore wind activity could lead to port expansion and increased port utilization in Massachusetts, Rhode Island, Connecticut, New York, and other states along the U.S. East Coast (Section G.2.7, Land Use and Coastal Infrastructure). Offshore wind developers committed to upgrade or expand port infrastructure and utilization in some locations. For example, Ørsted has committed to improvements to Rhode Island ports in support of the Revolution Wind Project (Kuffner 2018). 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 would likely be a small percentage of available benthic habitat overall. Increases in port utilization due to other offshore wind energy projects would lead to increases in vessel traffic and associated risk of vessel strike (see traffic IPF below). This increase would be at its peak during construction activities 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 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. Alternative A would include up to

2,955 foundations, 13,351 acres of new scour protection, and hard protection atop cables (Table E-1). Projects may also install more buoys and met towers. Structures would be added intermittently beginning in 2022 and continuing through 2030 and beyond, and they would remain until decommissioning of each facility is complete (30 years).

Human-made 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. 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 for the proposed Project, background conditions would return approximately 328 feet 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 existing conditions within a short distance.

The changes in fluid flow caused by the presence of an estimated 2,955 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 D. 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. 2016). During summer, local upwelling and 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). 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; van Berkel et al. 2020). During times of stratification (summer), increased mixing due the presence of structures could possibly increase pelagic primary productivity in local areas (Degraer et al. 2020; English et al. 2017; Kellison and Sedberry 1998). However, changes in primary productivity might not translate to impacts on marine mammal prey species if the increased productivity is consumed by filter feeders, such as mussels, that colonize the surface of the structures (Degraer et al. 2020; Slavik et al. 2019). In addition, the reduction of wind speed at the surface downstream of the windfarm leads to decreases in horizontal and vertical mixing, which may extend tens of kilometers around the windfarm and can affect temperature and salinity distributions and, ultimately, local primary productivity (Christiansen et al. 2022). The impacts 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 a localized increase of prey items for some marine mammal species at individual WTG foundations. Individual WTG and ESP foundations could increase the mixing of surface waters and deepen the thermocline, possibly increasing pelagic productivity in local areas (Degraer et al. 2020; English et al. 2017; Kellison and Sedberry 1998). However, the overall impact of the large number of structures may result in reduced mixing that could potentially overwhelm any localized impacts due to individual monopiles. 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 (Degraer et al. 2020; 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 (Pezy et al. 2018; Raoux et al. 2017; 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. Current data suggest seals (Russell et al. 2014) 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 wind development areas. As such, some marine mammals (e.g., 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 benthic productivity, potentially increasing prey availability for some marine mammal species at individual monopile locations, relative to surrounding locations (English et al. 2017). However, the overall impacts associated with the large number of monopiles may reduce overall mixing and overwhelm local benefits at individual WTG foundations.

While there is some uncertainty as described above, the anticipated reef effect would be expected to result in beneficial impacts on several groups of marine mammals due to increased prey availability. However, 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 concentrate recreational fishing around foundations, both personal and for-hire, and would also increase the risk of gear loss/damage by entanglement, potentially increasing the risk of entanglement in both lines and nets and increasing the risk of injury and mortality due to infection, starvation, or drowning (Moore and van der Hoop 2012). Additionally, commercial and recreational fishing vessels may be displaced outside of the RI/MA Lease Areas. Alternative A would impact all fisheries and all gear types. 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. In addition to displacement of fishing effort to areas outside of the RI/MA Lease Areas, some potential exists for a shift in gear types from fixed to mobile, or from mobile to fixed gear, due to displacement from the RI/MA Lease Areas. Although a potential for gear shift exists due to a change in the location of fishing effort, the potential impact on marine mammals is uncertain. However, if such a shift in gear types would occur, it may result in a potential increase in the number of vertical lines in the water column if there is no commensurate reduction in fixed gear types to mobile gear. In such circumstances of a greater shift of mobile gear to fixed gear, there would be a potential increase in the number of vertical lines, resulting in an increased risk of marine mammal interactions with fishing gear. Fisheries interactions, including various gillnet and trawl fisheries in New England and the Mid-Atlantic Coast, are likely to have demographic impacts 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). Current estimates indicate that 83 percent of NARWs show evidence of at least one past entanglement and 60 percent with evidence of multiple fishing gear entanglements, with rates increasing over the past 30 years (King et al. 2021, Knowlton et al. 2012). Of documented NARW entanglements in which gear was recovered, 80 percent was attributed to non-mobile fishing gear (i.e., lobster, gillnet) (Knowlton et al. 2012). Additionally, recent literature indicates that the proportion of NARW mortality attributed to fishing gear entanglement is likely higher than previously estimated from recovered carcasses (Pace 2021). Entanglement may also be responsible for high mortality rates in other large whale species, most notably humpback, minke, and fin whales (Henry et al. 2020; Read et al. 2006).

Abandoned or lost fishing gear may get tangled with foundations, reducing the chance that abandoned gear would 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 and intermittent impacts would persist until decommissioning is complete and structures are removed. The presence of structures and the anticipated reef effect have the potential to lead to increased recreational fishing within the lease areas and result in moderate exposure and high-intensity risk of interactions with fishing gear that may lead to entanglement, ingestion, injury, and death (Moore and van der Hoop 2012). The reef effect may result in drawing in recreational fishing effort from inshore areas, and overall interaction between marine mammals and fisheries resulting from increased effort offshore could increase if marine mammals are also drawn to the RI/MA Lease Areas due to increased prey abundance. Fishing and use of fishing gear for pre- and post-construction monitoring of future wind development 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 IPF 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. Additional species-specific information regarding the potential impacts of fishing gear entanglement is provided in B.5 in Appendix B. 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 construction of future offshore wind development may occur. Additionally, some marine mammals may avoid the lease areas during all stages (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 uncertainty relative to large whale responses from the presence of offshore WTG structures. Long-term and 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 RI/MA Lease Areas during construction of projects into areas with higher risk of interactions with fishing and commercial vessels (see traffic IPF below) may also contribute to impacts on marine mammals.

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 U.S. and Canadian eastern seaboard (Kite-Powell et al. 2007). Additional details regarding the potential impacts of vessel strike on NARW and other marine mammals potential present in geographic analysis area are provided in section B.5 in Appendix B.

Marine mammals are more vulnerable to vessel strike when they are within the draft of the vessel and 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 lethal vessel strikes of NARWs (Vanderlaan and Taggart 2007), whereas serious injury is less likely at speeds below 10 knots (Laist et al. 2001; Rockwood et al. 2020). Data show that the probability of a lethal vessel strike increases with the velocity of a vessel (Pace and Silber 2005; Vanderlaan and Taggart 2007). The increase in vessel traffic associated with future offshore wind development has the potential to increase the risk of marine mammal/vessel interactions, which have been known to cause serious injury and mortality in other large whale species, including fin, blue, and humpback whales (Berman-Kowalewski et al. 2010; Douglas et al. 2008; Rockwood et al. 2021). Offshore wind development would result in only a small incremental increase in vessel traffic volume relative to ongoing and future non-offshore activities, and minimal overall impacts would be expected as result. Some level of overall impacts can be expected should multiple projects be in the construction stage simultaneously. For example, at the peak of proposed construction, up to 896 vessels associated with offshore wind development along the U.S. East Coast may be operating in the geographic analysis area. This increase in vessel traffic would be added to the already high existing vessel traffic in the greater southern New England area (NMFS 2020a). At this time, there is currently a high degree of uncertainty regarding the number of vessels, ports to be used, and primary transit routes that future offshore wind developments would use. Additional information regarding the expected increase in vessel traffic is provided in Section 3.13, Navigation and Vessel Traffic.

The increase in vessel traffic associated with future offshore wind development has the potential to increase the risk of marine mammal/vessel interactions, which have been known to cause serious injury and occasional mortality in large whales (Berman-Kowalewski et al. 2010; Douglas et al. 2008; Laggner 2009; Lammers et al. 2003; NMFS 2020a). Collision risk would only be expected when project vessels are transiting to and from their respective lease areas. Once in the lease areas, vessels would be stationary during construction activities, and no appreciable 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 lease areas. While BMPs and mitigation and monitoring 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. This increased collision risk has the potential to result in injury or mortality to individuals. The relative risk of vessel strikes from offshore wind industry vessels is dependent on the stage of development, time of year, number of vessels, and speed of vessels during each stage.

Temporary and/or permanent increases in vessel traffic outside of lease areas may also occur due to displacement of commercial and recreational fishing vessels. Alternative A would likely 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. Displacement of these vessels and gear types may lead to increased interactions with marine mammals that may also be temporarily or permanently displaced out of the lease areas.

Conclusions

Impacts of Alternative A. Under Alternative A, marine mammals would continue to follow current regional trends and respond to current and future environmental and societal activities. While the proposed Project would not be built as proposed, ongoing activities, would have continuing temporary to permanent impacts (disturbance, displacement, injury, mortality, and reduced reproductive and foraging success) on marine mammals, primarily through pile-driving noise, vessel noise, presence of structures, vessel traffic, presence of structures (specifically related to interactions with commercial and recreational fisheries gear), and climate change. Impacts from ongoing activities, especially traffic and noise, as well as fisheries gear interactions, would be **minor**, as population-level impacts are not expected. However, for marine mammal species with a PBR approaching zero, such as the NARW, ongoing threats such as vessel strike and fishing gear entanglement can elevate impacts to **moderate** because a notable and measurable impact is anticipated, but the resource would likely recover when IPF stressors are removed.

Cumulative Impacts of Alternative A. In addition to ongoing activities, planned activities other than offshore wind may also contribute to impacts on marine mammals. These activities include increasing vessel traffic, new submarine cable and pipeline installation and maintenance, marine surveys, marine minerals extraction, port expansion, channel deepening activities, military readiness activities, and the installation of new towers, buoys, and piers. The impacts of planned activities other than offshore wind would be **minor**, as population-level impacts are not expected. However, for marine mammal species with a PBR approaching zero, such as the NARW, ongoing threats such as vessel strike and fishing gear entanglement can elevate impacts to **moderate** because a notable and measurable impact is anticipated, but the resource would likely recover when IPF stressors are removed. The combination of ongoing and planned activities would result in **moderate** impacts on marine mammals, primarily driven by ongoing noise impacts, interaction with commercial and recreational fisheries gear, and vessel traffic.

The overall impacts associated with future offshore wind activities in the geographic analysis area would result in **moderate** impacts on marine mammals due to the presence of structures, pile-driving noise, and traffic during construction. Additionally, the presence of structures could potentially result in **minor** beneficial impacts on some marine mammal species. 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 cable emplacement and maintenance and EMF, but impacts on marine mammals resulting from these IPFs would be localized and temporary and would not be expected to be biologically significant. The offshore wind industry would be responsible for a majority of the impacts associated with pile-driving noise, which could lead to **moderate** impacts on marine mammals in the geographic analysis area. However, overall, these impacts would not be expected to result in stock or population-level impacts.

Considering all of the impacts together, the cumulative impacts of ongoing and planned activities, would result in **moderate** adverse impacts and could potentially include **minor** beneficial impacts.

3.7.2.2 Relevant Design Parameters and Potential Variances in Impacts

The following proposed Project design parameters (Appendix C, Project Design Envelope and Maximum-Case Scenario) would influence the magnitude of impacts on marine mammals:

- The WTG foundation type used. The potential acoustic impacts on marine mammals are different for each foundation type that uses driven piles. For example, although monopile foundations have a higher sound-source level than jacket-type piles due to higher hammer power required, more jacket-type piles would be installed per day (up to four 13-foot pin piles per jacket), increasing the risk of PTS to marine mammals (COP Appendix III-M; Epsilon 2022a). Consequently, cumulative SELs are higher for marine mammals with jacket foundations than monopiles (COP Appendix III-M; Epsilon 2022a).
- Sound produced by pile driving. To assess daily underwater sound produced by pile driving, sound from each pile type would be analyzed independently due to differences in source levels produced by the hammer power needed to drive each pile type, daily pile-driving duration for each foundation type, and the frequency spectrum produced by each pile diameter. Depending on the species' hearing differences and pile differences, the relative impacts on each hearing group vary considerably, warranting a separate analysis for each pile type.
- Total days of pile driving. At the installation rate of one monopile or jacket foundation per day, the applicant would need a total of 62 days of pile driving. At two monopiles foundation installed per day, only 31 days of pile driving would be needed. In terms of total days of pile driving, the maximum-case scenario would be 62 days of work (COP Appendix III-M; Epsilon 2022a).
- Vessels and ports. The proposed Project would use a number of ports during proposed Project activities. Section 2.1.2 provides more details.
- Mitigation and monitoring measures. In instances where the implementation of a mitigation or monitoring measure could have a measurable reduction in the level of the stressor of a potential impact, that measure would be considered in the level of impact in the analysis.

Aspects of the proposed Project design include the OECC, the WTG design selected (e.g., 13 MW, 16 MW), the exact placement and number of WTGs and ESPs, the final inter-array cable layout, and the construction schedule, which would be determined based on-site assessment data, engineering requirements, and other factors. Although some variation is expected in the design parameters, the impact assessment analyzes the maximum-case scenario.

3.7.2.3 Impacts of Alternative B – Proposed Action on Marine Mammals

This section identifies the potential impacts of Alternative B on marine mammals. Alternative B would contribute to impacts (disturbance, displacement, injury, mortality) on marine mammals across the range of IPFs discussed in Section 3.7.2.1. Temporary to permanent impacts are possible. The most impactful IPFs associated with Alternative B would likely include noise (specifically from pile-driving), which could cause noticeable temporary impacts for 4 to 6 hours per day during construction; traffic, which could lead to injury and/or mortality; and the presence of structures, which would lead to permanent impacts that may be either adverse or beneficial. Other IPFs would likely contribute impacts of lesser intensity and extent and would occur primarily during construction but also during operations and decommissioning. Imposed mitigation and monitoring measures could result in a measurable reduction in the level of impacts experienced by affected marine mammals.

Impacts of Phase 1

Phase 1 would affect marine mammals through the following primary IPFs during construction, operations, and decommissioning.

Accidental releases: The incremental impacts of Phase 1 construction, operations, and decommissioning from accidental releases of hazardous materials and trash/debris would not increase the risk beyond that described under Alternative A. Further, Phase 1 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 proposed Project personnel, reducing the likelihood of an accidental release (COP Appendix I-F; Epsilon 2022a). In the unlikely event of an accidental oil spill, oil may impact marine mammals within 20 to 50 miles of the spill, based on modeling performed for Vineyard Wind 1 (COP Appendix I-F; Epsilon 2022a). The impacts would be sublethal due to quick dispersion, evaporation, and weathering, all of which would limit the amount and duration of exposure of marine mammals to hydrocarbons. The applicant would have an OSRP in place that would decrease potential impacts from spills. Informational training on proper storage and disposal practices to reduce the likelihood of accidental discharges would further reduce the likelihood of an accidental spill from occurring. Therefore, due to the unlikelihood of an oil spill, the sublethal level of impact, the implementation of an OSRP, and proposed Project personnel training, potential temporary impacts on marine mammals from accidental releases of oil or fuel, fluids, trash or debris, and other hazardous materials during Phase 1 construction, operations, and decommissioning would be **negligible**, if at all, due to the rare, brief, and highly localized nature of accidental releases.

Anchoring and gear utilization: Monitoring survey methods for Alternative B may include otter trawl, ventless trap sampling, lobster tagging, Neuson net sampling, video and still imaging, and grab sampling. As described in Section 3.7.2.1, survey gear could affect marine mammals through entanglement or entrapment. Trawl nets pose a discountable threat to mysticetes, and the slow speed of mobile gear and the short tow times (less than 30 minutes) further reduce the potential for entanglements or other interactions. Fish traps and anchoring lines and buoys used to secure them may pose an entanglement risk to marine mammals, although these risks would be mitigated because trap surveys would be required to utilize mitigation measures to further reduce entanglement risk (e.g., ropeless gear, biodegradable components). Therefore, impacts on marine mammals from traps are expected to be **negligible** based on the limited number of associated buoy lines, the short duration of sampling events, and low probability for gear entanglement Given the short-term, low-intensity, and localized nature of the impacts of gear utilization for Alternative B, as well as the proposed mitigation and minimization measures, impacts on mysticetes, odontocetes, and pinnipeds would be **negligible**.

Cable emplacement and maintenance: Phase 1 would incrementally disturb up to 442 acres of seafloor by cable installation, which would include up to 52 acres affected by dredging prior to cable installation that would result in turbidity impacts with the potential for temporary impacts on some marine mammal prey species. Model results indicate moderate to relatively high turbidity plumes may be possible extending several miles from the OECC centerline, with concentrations persisting several hours as a result of dredging and dumping activities, though this may be less extensive at varying locations along the route (COP Appendix III-A; Epsilon 2022a). Elevated turbidity levels would be short term and temporary, and several marine mammal species reside often in turbid waters, so significant impacts from turbidity are not likely (Todd et al. 2015). Sediment dispersal model results indicate that during inter-array cable-laying activities, most of the mass settles out quickly and is not transported for long by the currents. Modeling results predict the sediment plume is confined to the bottom few feet of the water column, which is only a fraction of the total water column in the SWDA (COP Appendix IIIA; Epsilon 2022a). Therefore, there would be short-term and localized water quality impacts from inter-array cable installation and undetectable **negligible** impacts on marine mammals from turbidity. 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 or perhaps via echolocation within turbid areas, and only **negligible** impacts, if any, on individuals would be expected given the localized and temporary nature of the potential impacts.

Phase 1 operations would require routine preventative maintenance and equipment inspections. These activities could involve activities similar to those described for construction, but they would be limited to the cable segment being maintained or repaired. As a result, Phase 1 cable maintenance impacts on marine mammals would be **negligible**.

Climate change: Global climate change is an ongoing risk to marine mammals. The surveying, construction, and decommissioning activities associated with the proposed Project would produce GHG emissions that would contribute to climate change; however, these contributions would be small compared with the aggregate global emissions and would be less than the emissions offset during the operations of the offshore wind facility. The impact of GHG emissions on marine mammals from proposed Project construction would not be detectable and would, thus, be **negligible**.

Operations of Phase 1 would marginally reduce or displace emissions from conventional power generation, thereby contributing to slowing or arresting global warming and associated climate change and having a long-term and **negligible** beneficial impact on marine mammals. Emissions associated with decommissioning would offset some of these **negligible** to **minor** beneficial impacts.

EMF: Both OECC and inter-array cable arrays are high-voltage AC, and the applicant would bury these cables at a depth of 5 to 8 feet. Modeled and measured magnetic field levels from various existing submarine power cables indicate that AC cables buried to a depth of 3 feet would emit field intensities less than 0.05 µT up to 82 feet above the cable and 79 feet along the seafloor. While EMF associated with the proposed Project's submerged cables once powered would be detectable by marine mammals, **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.

Noise: A short-term increase in underwater noise could affect marine mammals, predominantly during impact pile driving used to install WTG and ESP foundations. Other anticipated construction activities that would result in noise include cable laying, vessel noise, and aircraft noise. Noise produced by impact pile driving for the installation of WTG and ESP foundations is expected to be the IPF with the greatest potential for impact on marine mammals. Acoustic modeling of pile driving activities was conducted and is presented in the proposed Project COP (Appendix III-M; Epsilon 2022a). For the purposes of the acoustic modeling, multiple construction scenarios were assessed including two foundation types (jacket and monopile); three pile sizes; two impact hammer energies (for monopile foundation types only); and three levels of noise attenuation (0-, 10-, and 12-dB attenuation) (COP Appendix III-M; Epsilon 2022a). For the purposes of this assessment, two pile sizes were assessed for Phase 1 (the 4-meter jacket and the 12-meter monopile foundations), and two pile sizes were assessed for Phase 2 (the 4-meter jacket and the 13-meter monopile foundations), which are described further under Phase 2. The results summarized here represent the maximum potential ranges modeled, meaning the results provided assume the highest hammer energy included in the acoustic modeling was used to assess the potential for impacts on marine mammals.

Additionally, the acoustic modeling provided exposure-based ranges that incorporate animal movement modeling to provide a realistic estimate of the ranges at which moving animals may exceed the acoustic thresholds from Table 3.7-6. To estimate exposure ranges, pile strikes are propagated within the modeling assessment area to create an ensonified environment while simulated animals (i.e., animats) are moved about the ensonified area following known species-specific behaviors. Modeled animats that have received sound energy exceeding the acoustic threshold criteria are registered, and the closest point of approach recorded at any point in that animal's movement is then reported as its exposure range. This process is repeated multiple times for each animat to produce the exposure-based ranges, which comprise the closest point of approaches for 95% of animats that exceeded the threshold (i.e., 95th percentile exposure-based ranges [$ER_{95\%}$]) (COP Appendix III-M; Epsilon 2022a).

Noise mitigation systems, such as those proposed by the applicant (COP Volume 3, Section 6.7.4; Epsilon 2022a) and described within the Noise IPF in Section 3.7.2.1 and Appendix H, Mitigation and Monitoring, are often used to create a local barrier around a sound source, which acts as an impedance to noise transmission (COP Appendix III-M; Epsilon 2022a). This was incorporated into the modeling in the source propagation component, whereby a broadband reduction of 10 or 12 dB was applied to the noise produced by the modeled pile strikes. As a result, this reduces the sound propagated through the water column and decreases the range over which above-threshold noise will travel (COP Appendix III-M; Epsilon 2022a).

There is a potential risk of noise impacts on marine mammals from impulsive pile-driving activities for Phase 1 due to the large radial distance to PTS and behavioral harassment thresholds over the maximum total of 62 days that pile driving may occur. Up to 63 foundations (including up to 2 ESPs, with the remainder for WTGs) would be installed during Phase 1 of the proposed Project. The Phase 1 PDE includes two WTG foundation types: monopiles and jacket foundations, both of which would be installed using impact pile driving. Table 3.7-7 summarizes modeled predicted exposure ranges for 4-meter jacket pile foundations with 0-, 10-, and 12-dB attenuation and 3,500 kJ hammer energy. Unattenuated $ER_{95\%}$ to the SEL_{24h} PTS thresholds were estimated to be 4.9 to 8.3 miles (7.9 to 13.3 kilometers) for LFC species; 0 to 0.05 mile (0 to 0.08 kilometer) for MFC species; 3.7 miles (5.9 kilometers) for HFC; and 1.8 to 2.7 miles (2.9 to 4.4 kilometers) for PPW species for jacket foundation pile driving. Modeling results for the Lpk threshold were all smaller than the SEL_{24h} threshold, so these ranges were used in this assessment to represent the highest risk of exposure to noise sufficient to elicit PTS in marine mammals from pile-driving activities. With up to 10 dB noise attenuation, the $ER_{95\%}$ for the SEL_{24h} PTS thresholds are reduced to 1.1 to 2.8 miles (1.8 to 4.5 kilometers) for LFC species; 0 to 0.01 miles (0 to 0.01 kilometer) for MFC species; 1.1 miles (1.8 kilometers) for HFC species; and 0.2 to 0.8 miles (0.3 to 1.3 kilometers) for PPW species. Behavioral disturbances may also occur during jacket foundation pile driving, as unattenuated ranges to behavioral thresholds were estimated to be 5.0 to 5.3 miles (8.0 to 8.5 kilometers) for LFC species; 4.0 to 5.2 miles (6.4 to 8.4 kilometers) for MFC species; 4.9 miles (7.9 kilometers) for

HFC species; and 5.2 to 5.3 miles (8.3 to 8.5 kilometers) for PPW species (Table 3.7-8). With 10 dB noise attenuation, these $ER_{95\%}$ are reduced to 2.0 to 2.2 miles (3.3 to 3.6 kilometers) for LFC species; 1.8 to 2.1 miles (2.9 to 3.4 kilometers) for MFC species; 2.1 miles (3.4 kilometers) for HFC species; and 2.1 to 2.2 miles (3.4 to 3.5 kilometers) for PPW species (Table 3.7-8).

Table 3.7-9 summarizes modeled predicted exposure ranges for monopile foundations with 0-, 10-, and 12-dB attenuation. Unattenuated $ER_{95\%}$ to the SEL_{24h} PTS thresholds were estimated to be 5.7 to 8.5 miles (9.2 to 13.6 kilometers) for LFC species; 0 to 0.12 mile (0 to 0.19 kilometer) for MFC species; 4.3 miles (7.0 kilometers) for HFC; and 1.9 to 2.1 miles (3.1 to 3.3 kilometers) for PPW species for 12-meter monopile foundation installation using 6,000 kJ hammer energy. With up to 10 dB noise attenuation, the $ER_{95\%}$ for the SEL_{24h} PTS thresholds are reduced to 1.6 to 2.9 miles (2.6 to 4.6 kilometers) for LFC species; 0 to 0.01 mile (0 to 0.01 kilometer) for MFC species; 1.4 miles (2.3 kilometers) for HFC species; and 0.25 to 0.6 mile (0.41 to 1.0 kilometer) for PPW species (Table 3.7-9). Behavioral disturbances may also occur during jacket foundation pile driving, as unattenuated ranges to behavioral thresholds were estimated to be 9.0 to 9.8 miles (14.5 to 15.8 kilometers) for LFC species; 8.8 to 9.6 miles (14.1 to 15.4 kilometers) for MFC species; 9.1 miles (14.6 kilometers) for HFC species; and 9.6 to 9.8 miles (15.4 to 15.8 kilometers) for PPW species (Table 3.7-8). With 10 dB noise attenuation, these $ER_{95\%}$ are reduced to 3.3 to 3.7 miles (5.3 to 6.0 kilometers) for LFC species; 3.0 to 3.7 miles (4.9 to 5.9 kilometers) for MFC species; 3.4 miles (5.5 kilometers) for HFC species; and 3.7 to 3.8 miles (5.9 to 6.1 kilometers) for PPW species (Table 3.7-9).

Table 3.7-8: 95th Percentile Exposure-Based Ranges (in Meters) to Injury and Behavioral Thresholds, Four 4-Meter Jacket Foundation Piles per day, 3,500 Kilojoule Hammer Energy with Noise Attenuation[a]

	Distance to Injury Threshold (SEL_{24h})			**Distance to Behavioral Threshold (SPL)**		
Species	**0 dB**	**10 dB**	**12 dB**	**0 dB**	**10 dB**	**12 dB**
LFC						
Fin whale (*Balaenoptera physalus*)	13,290	4,070	3,140	8,470	3,560	3,290
Minke whale (*Balaenoptera acutorostrata)*	7,870	1,830	1,260	8,000	3,340	3,200
Humpback whale (*Megaptera novaeangliae)*	13,830	4,490	3,250	8,440	3,560	3,280
NARW (*Eubalaena glacialis)*	10,370	2,540	1,740	8,150	3,340	3,160
Sei whale (*Balaenoptera borealis)*	10,900	2,840	1,890	8,220	3,390	3,230
MFC						
Atlantic white-sided dolphin (*Lagenorhynchus acutus)*	10	10	10	8,020	3,270	3,120
Atlantic spotted dolphin (*Stenella frontalis)*	0	0	0	8,400	3,260	3,170
Short-beaked common dolphin (*Delphinus delphis)*	10	10	0	7,980	3,340	3,150
Common bottlenose dolphin (*Tursiops truncates)*	80	10	0	6,440	2,870	2,590
Risso's dolphin (*Grampus griseus)*	10	10	10	8,270	3,380	3,160
Long-finned pilot whale (*Globicephala melas)*	10	10	0	7,960	3,300	3,100
Short-finned pilot whale (*Globicephala macrorhynchus)*	10	0	0	7,950	3,370	3,160
Sperm whale (*Physeter macrocephalus)*	10	10	0	8,170	3,360	3,110

	Distance to Injury Threshold (SEL_{24h})			Distance to Behavioral Threshold (SPL)		
Species	**0 dB**	**10 dB**	**12 dB**	**0 dB**	**10 dB**	**12 dB**
HFC						
Harbor porpoise (*Phocoena phocoena)*	5,900	1,770	1,290	8,150	3,380	3,210
PPW						
Gray seal (*Halichoerus grypus)*	4,350	1,310	960	8,520	3,490	3,380
Harbor seal (*Phoca vitulina)*	3,330	320	120	8,330	3,440	3,120
Harp seal (*Pagophilus groenlandicus)*	2,850	280	150	8,440	3,490	3,240

Source: COP Appendix III-M Table 36; Epsilon 2022a

μPa^2 s = micropascal squared second; dB = decibel; HFC = high-frequency cetacean; kJ = kilojoule; LFC = low-frequency cetacean; Lpk = peak sound pressure (dB re 1 μPa); MFC = mid-frequency cetacean; NARW = North Atlantic right whale; PPW = phocid pinnipeds in water; SEL_{24h} = sound exposure level over 24 hours (dB re 1 μPa^2 s); SPL = root-mean-square sound pressure level (dB re 1 μPa)

[a] This reflects 95th percentile ranges in meters and assumes four, 4-meter piles installed per day using 3,500 kJ hammer energy.

Table 3.7-9: 95th Percentile Exposure-Based Ranges (in Meters) to Injury and Behavioral Thresholds, Two 12-Meter Monopile Foundations per Day, 6,000 Kilojoule Hammer with Noise Attenuation[a]

	Distance to Injury Threshold (SEL_{24h})			Distance to Behavioral Threshold (SPL)		
Species	**0 dB**	**10 dB**	**12 dB**	**0 dB**	**10 dB**	**12 dB**
LFC						
Fin whale (*Balaenoptera physalus*)	12,550	3,900	2,860	15,820	6,010	4,910
Minke whale (*Balaenoptera acutorostrata)*	9,230	2,590	1,820	14,650	5,330	4,390
Humpback whale (*Megaptera novaeangliae)*	13,590	4,620	3,600	15,780	5,920	4,720
NARW (*Eubalaena glacialis)*	11,160	3,160	2,490	14,510	5,600	4,450
Sei whale (*Balaenoptera borealis)*	11,070	3,080	2,250	15,400	5,790	4,790
MFC						
Atlantic white-sided dolphin (*Lagenorhynchus acutus)*	0	0	0	14,090	5,400	4,290
Atlantic spotted dolphin (*Stenella frontalis)*	0	0	0	15,030	5,470	3,950
Short-beaked common dolphin (*Delphinus delphis)*	20	0	0	14,350	5,540	4,340
Common bottlenose dolphin (*Tursiops truncates)*	190	0	0	14,120	4,930	3,770
Risso’s dolphin (*Grampus griseus)*	30	10	10	15,390	5,890	4,540
Long-finned pilot whale (*Globicephala melas)*	0	0	0	14,650	5,500	4,430
Short-finned pilot whale (*Globicephala macrorhynchus)*	20	0	0	14,600	5,620	4,430
Sperm whale (*Physeter macrocephalus)*	290	0	0	14,980	5,840	4,580
HFC						
Harbor porpoise (*Phocoena phocoena)*	7,010	2,300	1,690	14,630	5,480	4,530
PPW						

Species	Distance to Injury Threshold (SEL_{24h})			Distance to Behavioral Threshold (SPL)		
	0 dB	**10 dB**	**12 dB**	**0 dB**	**10 dB**	**12 dB**
Gray seal (*Halichoerus grypus)*	3,290	1,010	560	15,830	6,050	4,920
Harbor seal (*Phoca vitulina)*	3,310	630	190	15,370	6,030	4,780
Harp seal (*Pagophilus groenlandicus)*	3,070	410	200	15,690	5,970	4,860

Source: COP Appendix III-M Table 33; Epsilon 2022a

μPa^2 s = micropascal squared second; dB = decibel; HFC = high-frequency cetacean; kJ = kilojoule; Lpk = peak sound pressure (dB re 1 µPa); LFC = low-frequency cetacean; MFC = mid-frequency cetacean; NARW = North Atlantic right whale; PPW = phocid pinnipeds in water; SEL_{24h} = sound exposure level over 24 hours (dB re 1 μPa^2 s); SPL = root-mean-square sound pressure level (dB re 1 µPa)
[a] This reflects 95th percentile ranges in meters and assumes two, 12-meter piles installed per day using 6,000 kJ hammer energy.

The applicant has committed to implement measures, including soft start, a noise attenuation system, visual PSOs, and PAM, which are designed to reduce the potential impacts on marine mammals.[19] Pile-driving sound attenuation technology under consideration for the applicant includes piling equipment optimized for sound reduction (e.g., integrated pile installer), underwater noise abatement systems (e.g., AdBm encapsulated bubble sleeve), and/or bubble curtains. Various studies have demonstrated these mitigation and monitoring measures are capable of attenuating sounds during pile driving by approximately 10 to 23 dB (Bellmann 2014; Christopherson and Lundberg 2013; Reinhall et al. 2015). Attenuation levels vary by equipment type, frequency band, and location, which is part of the reason multiple attenuation levels were included in the acoustic modeling assessment (COP Appendix III-M; Epsilon 2022a). The modeling assessment also includes the seasonal restriction wherein no pile driving would occur during the peak season of NARW occurrence in the SWDA (between January 1 and April 30) to help reduce the impacts on this species and others with seasonal occurrence (Section 3.7.1) would be avoided during this timeframe, as no pile driving would occur. Additional detail on the voluntary measures the applicant has committed to are described in detail in Appendix H. Additional measures that must be applied to the proposed Project, including mandatory terms and conditions and reasonable and prudent measures to minimize the extent or amount of incidental take of endangered species, are included as part of the Incidental Take Statement (ITS) included with the BO issued by NMFS. General conditions and mitigation and monitoring measures relative to marine mammals provided in the LOA are also discussed in detail in Appendix H.

Overall, the modeled predicted exposure rates and threshold distances (COP Appendix III-M; Epsilon 2022a) indicate that the risk of PTS is lowest for MFC due to the of the small number of individuals of any species that would be exposed to pile-driving noise and that any impacts would be **minor** and would not result in long-term impacts on any population. In this group, only the sperm whale is endangered; no injury or mortality of any sperm whales is anticipated, and impacts would be limited to temporary behavioral disruptions of a very small number of individuals. For all other hearing groups under the maximum-case scenario, the modeled predicted risk of non-lethal auditory injury was higher without noise attenuation or aversion used in the modeled scenarios (COP Appendix III-M; Epsilon 2022a). However, as shown in the modeling results, the inclusion of noise attenuation systems that are expected to result in a minimum of 10 dB reduction in noise levels would help reduce the size of the $ER_{95\%}$ ranges, which reduces the risk of exposure. Based on the analysis, BOEM considers impacts from pile driving to be **minor** on NARW due to avoidance of peak seasons of occurrence and the extensive mitigation and monitoring measures that are specific to the species. While the NARW mitigation and monitoring measures outlined in Appendix H are species-specific, they would provide some protections to other

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[19] While the applicant 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 BO and LOA issued for the proposed Project.

species in the region. BOEM considers impacts from pile driving to be **moderate** for all other marine mammal hearing groups, except MFC species for which impacts would be **minor**; no long-lasting, population-level impacts are expected. The most likely impacts that may occur are **moderate** behavioral disturbances for all marine mammal species (inclusive of all hearing groups) potentially present during pile-driving activities. The applicant may potentially achieve approximately 12 dB or greater noise attenuation, which would further reduce the distances to thresholds for all hearing groups (COP Appendix III-M; Epsilon 2022a); however, 10 dB noise attenuation is considered the most realistic to achieve and, thus, was assumed for this impact assessment. No population-level impacts are expected for any marine mammal hearing group, and impacts from pile driving overall are expected to be **moderate**. Pile-driving activities would be conducted in accordance with the proposed Project BO, LOA, and all measures provided in Appendix H that would require the use of PSOs, PAM, monitoring zones, and other mitigation and monitoring measures to minimize impacts on marine mammals. The use of noise-reduction technologies during all pile-driving activities to ensure a minimum attenuation of 10 dB would reduce the area of high noise levels during construction and subsequently minimize potential noise-related impacts on marine mammals. With noise mitigation and the additional proposed mitigation and monitoring measures, it is not expected any marine mammal would experience permanent impacts from pile driving such as PTS. It is likely behavioral disturbances would occur, but these are expected to be short term and would dissipate once the pile driving has ceased. No population-level impacts are expected.

Take estimates of marine mammals during construction of the proposed Project will be provided in the proposed Project LOA issued by NMFS.

Vibratory pile setting and drilling activities may also be conducted prior to impact pile driving to reduce the risk of pile run, an effect where unstable soil conditions cause the pile to move under its own weight through the soil in an uncontrolled manner (JASCO 2022). Ranges to the PTS thresholds for these activities were estimated using the NMFS online User Spreadsheet Tool (NMFS 2020c), and ranges to behavioral thresholds were estimated using practical spreading loss equations (JASCO 2022). PTS ranges for all marine mammal hearing groups were less than 650 meters (2,132 feet) for vibratory setting and less than 350 meters (1,148 feet) for drilling, indicating a low risk of auditory impacts for any marine mammal species (JASCO 2022). The behavioral threshold ranges were estimated to exceed 50 kilometers (31 miles) for vibratory pile setting and 21.5 kilometers (13.4) for drilling (JASCO 2022) so behavioral disturbances may occur. However, not all piles will include vibratory setting or drilling activities; it was estimated that up to 79 of the 132 total piles may require vibratory pile setting across both proposed Project phases, and up to 48 piles of the 132 may require drilling across both proposed Project phases (JASCO 2022). Therefore, the duration of exposure to noise from these activities would be limited, making the likelihood of long-term avoidance of the area or population-level behavioral impacts extremely low. Additionally, all mitigation and monitoring measures described for impact pile driving, except the noise attenuation, would also apply to vibratory pile setting and drilling, further reducing the risk of any biologically relevant impacts. Vibratory setting and drilling would, therefore, result in **minor** impacts on marine mammals.

Initial geophysical survey results suggest there is a moderate risk of encountering UXOs within the SWDA and OECC. If UXOs are encountered, the applicant’s preferred approach is avoidance, by relocating WTG and ESP foundations and associated cables to avoid the UXOs. Where avoidance of UXOs is not feasible, the applicant would first pursue less impactful (low-order) disposal options such as lift and shift, cut and capture, low-order disposals, and deflagration; high-order disposals (i.e., in situ detonation) would be used as a last resort (JASCO 2022). Because low-order disposal methods may not be possible, the potential impacts from in situ UXO disposal assumed high-order detonations.

The acoustic modeling assessment for UXO detonations followed the study recently conducted for the Revolution Wind Project (Hannay and Zykov 2022). This study modeled UXO detonations in multiple locations to account for water depth and employed the use of U.S. Navy bins (Hannay and Zykov 2022).

This approach groups potential UXOs into five “bins” or categories based on the maximum UXO charge weights, as shown in Table 41 of the LOA application (JASCO 2022). Although slight bathymetric differences exist between the Revolution Wind Project area and the geographic analysis area for the proposed Project, the results from the Revolution Wind Project study are approximately transferrable and were, therefore, used for the modeling and exposure assessment (JASCO 2022). The applicant assumed that up to 10 UXOs would be encountered within the geographic analysis area during construction and modeled 0 and 10 dB noise attenuation. The estimated impact areas for species of concern to the PTS and TTS thresholds are provided in Table 3.7-10, and the impulse exceedance ranges to the non-auditory injury thresholds are provided in Table 3.7-11.

Table 3.7-10: Impact Areas (in Square Kilometers) to the Permanent Threshold Shift- and Temporary Threshold Shift-Onset Thresholds for Potential Unexploded Ordnance Detonations for Various Depths with 10 Decibels Noise Attenuation

	PTS Onset (Depth in Meters)				TTS Onset (Depth in Meters)			
Hearing Group	**12**	**20**	**30**	**45**	**12**	**20**	**30**	**45**
LFC	32.57	44.89	40.94	40.94	380.13	444.88	415.48	437.44
MFC	0.67	0.47	0.53	0.53	20.43	18.55	19.32	19.32
HFC	120.76	120.37	120.37	119.21	624.58	598.28	555.72	589.65
PPW	8.04	6.42	6.88	5.73	143.14	153.50	149.57	154.82

Source : JASCO 2022

HFC = high-frequency cetacean; LFC = low-frequency cetacean; MFC = mid-frequency cetacean; PPW = phocid pinnipeds in water; PTS = permanent threshold shift; TTS = temporary threshold shift

Table 3.7-11: Impact Areas (in Square Kilometers) to the Non-Auditory Injury Thresholds for Potential Unexploded Ordinance Detonations for Various Depths with 10 Decibel Noise Attenuation

	Onset of Lung Injury (Depth in Meters)				Onset of Mortality (Depth in Meters)			
Marine Mammal Group	**12**	**20**	**30**	**45**	**12**	**20**	**30**	**45**
Baleen and sperm whales (calf/pup)	151	204	226	237	90	105	109	108
Baleen and sperm whales (adult)	73	80	81	78	34	34	31	29
Pilot and minke whales (calf/pup)	192	275	310	330	120	150	157	162
Pilot and minke whales (adult)	103	126	131	132	56	58	57	50
Beaked whales (calf/pup)	250	366	413	448	161	206	220	234
Beaked whales (adult)	171	237	267	282	105	127	132	135
Dolphins, Kogia, and pinnipeds (calf/pup)	347	508	557	606	228	285	308	332
Dolphins, Kogia, and pinnipeds (adult)	241	351	400	429	154	198	211	224
Porpoises (calf/pup)	377	541	594	648	248	307	330	353
Porpoises (adult)	260	381	429	465	167	215	231	243

Source : JASCO 2022

Due to the proposed mitigation and monitoring measures (Appendix H) and the relatively small size of the peak pressure and acoustic impulse threshold ranges compared to PTS and TTS ranges for potential UXO detonations, no non-auditory injury or mortality is expected for any species (JASCO 2022). There is, however, potential for PTS and TTS during this activity. The estimated impact areas for PTS and TTS onset (Table 3.7-10) indicate the greatest risk of exposure for HFC species (e.g., harbor porpoise) with the lowest risk for MFC species. The assessment in the LOA application (JASCO 2022) assumed that up to 10 UXO would require detonation throughout construction. A noise attenuation system such as a bubble curtain would be used during UXO detonations to achieve approximately 10 dB broadband attenuation, and other mitigation such as pre-clearance surveys and visual monitoring would also be implemented to reduce the potential for impacts on marine mammals (Appendix H; JASCO 2022). Because no mortalities or non-auditory injury are expected to occur, no long-lasting population-level impacts are expected, and impacts on marine mammals from UXO detonations would be **moderate**.

Cable-laying noise associated with Phase 1 may also affect marine mammals. The timeframe for offshore export cable installation is still being developed in response to time-of-year considerations. 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 and monitoring measures would be implemented to minimize potential impacts. The sound exposure level over 24 hours (SEL_{24h}) during cable laying is expected to reach approximately 237 dB re 1 micropascal squared second (μPa^2 s) at 1 meter (3.3 feet) (Xodus Group 2015), which exceeds the NMFS threshold criteria for PTS from non-impulsive noise (SEL_{24h} 199 dB re 1 μPa^2 s) at that distance (COP Appendix III-M; Epsilon 2022a). The distance to the threshold for Level A Harassment is expected to be relatively small (Xodus Group 2015), and the distance to threshold for Level B Harassment is expected to be in the range of other vessel noise. Temporary and **minor** impacts are anticipated from cable-laying noise, with marine mammal populations fully recovering following cable installation.

G&G survey equipment may produce both impulsive and non-impulsive noise depending on the type of equipment. The BOEM BA for data collection and site survey activities for renewable energy on the Atlantic OCS (Baker and Howsen 2021) estimated that PTS threshold distances for mysticetes for some impulsive equipment may extend up to 43 feet, and non-impulsive equipment PTS threshold distances may extend up to 3 feet. Distances to PTS thresholds for sperm whales were all less than 3 feet. Behavioral disturbance threshold showed larger estimated distances, up to 1,640 feet for all marine mammals. However, these distances were estimated assuming the maximum operational power was used for all equipment, which is unlikely. Additionally, these surveys would have relatively short durations within the overall construction period. No acoustic injury is expected from operations of any G&G survey equipment, and mitigation (COP Volume III, Section 6.7.4, Table 6.7-20; Epsilon 2022a) would effectively reduce the risk of biologically significant behavioral disturbances. Impacts on marine mammals are, therefore, expected to be **negligible**.

Current vessel traffic in the OECC, SWDA, and surrounding waters is relatively high. COP Section 3.3.1.12.1 (Volume 1; Epsilon 2022a) indicates an average of 30 proposed Project-related vessels operating within the SWDA or along the OECC at any given time and up to approximately 60 proposed Project-related vessels operating concurrently within the SWDA during high-traffic periods. This traffic would vary monthly depending on weather and proposed Project activities. Over the course of construction, Phase 1 would generate an average of six daily vessel trips between both the primary and secondary ports and the SWDA. During the period of maximum activity, Phase 1 construction would generate an average of 15 construction vessel trips per day in or out of construction ports. (COP Volume I, Section 3.3.1; Epsilon 2022a). Vessel activities also include proposed Project-related biological surveys, including pre- and post-operations environmental surveys for fish and benthic habitat monitoring, though the magnitude of the vessel traffic is unknown at this time. The navigation safety risk assessment (COP Appendix III-I; Epsilon 2022a) provides further details of vessel activity during construction. The applicant would use vessels with ducted propeller thrusters, including DP systems. Of the different Phase 1 vessel types listed in COP Table 3.3-1 (Volume I, Section 3.3.1; Epsilon 2022a), all except smaller support vessels that use jet-drive propulsion are described as having “blade propeller system/blade thrusters.” Assuming sound sources for blade propeller system/blade thrusters are similar to those for ducted propellers, vessel noise may cause behavioral modification for some marine mammals. Sound-source levels for ducted propeller thrusters were modeled for a project offshore of Virginia (BOEM 2015) and measured during the installation of the Block Island Wind Farm transmission cable. For both projects, the root-mean-squared sound-source level was 177 dB re µPa-m. Ducted propeller thruster use may exceed threshold criteria for injury at a distance of 351 feet (BOEM 2014a). However, marine mammals would need to remain within that distance for a prolonged period to be impacted by PTS, which is extremely unlikely. Distances to the threshold criteria for behavioral modification for marine mammals would be approximately 0.9 to 2 miles. Potential behavioral impacts on marine mammals from Phase 1-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 OECC and SWDA, and are not expected to have stock or population-level impacts. Further, populations would be expected to fully recover once the IPF is removed, and no ESA take of marine mammals would be expected as a result of vessel presence and vessel noise (NMFS 2020a). Potential temporary behavioral impacts on all other marine mammals from vessel traffic are expected to be **minor,** with marine mammal populations fully recovering following construction of Phase 1 of the proposed Project.

Aircraft noise may result in behavioral responses in marine mammals when flying at altitudes below 984 feet. However, aircraft transiting to the SWDA would fly at altitudes above those that would cause behavioral responses from marine mammals except when flying low to inspect WTGs, conduct biological surveys, or to take off and land. Aircraft activities for Alternative B would include minimum altitude requirements for preventing impacts on marine mammals. While aircraft traffic may cause some short-term behavioral reactions in marine mammals, these impacts would be short term, temporary, and **negligible,** resulting in minimal energy expenditure.

Overall, the impacts of noise from Phase 1 construction on marine mammals would be **negligible** to **moderate**, depending on the source and species or species group affected. While the significance level of impacts would remain the same, BOEM could further reduce impacts on marine mammals by requiring as a condition of COP approval (in addition to the mitigation and monitoring measures proposed by the applicant) the reasonable and prudent measures required in a Project-specific ITS issued by NMFS under the ESA, and the conditions required in the final LOA to be issued by NMFS under the MMPA (Appendix H). The use of noise-reduction technologies during all pile-driving activities to ensure a minimum attenuation of 10 dB would reduce the area impacted by noise during construction. The specific technologies have not yet been selected; potential options include a noise mitigation system, hydro-sound damper, noise abatement system, a bubble curtain, or something similar (COP Appendix III-M; Epsilon 2022a). The use of PSOs during pile driving and G&G survey activities would reduce the potential noise impacts by establishing and maintaining exclusion zones to minimize marine mammal exposure to injurious levels of noise. The detectability of marine mammals is dependent on meteorological conditions, PSO training, PSO fatigue, animal behavior, and vocalization rates (relevant for PAM). PSO training and shift requirements, as detailed in Appendix H, would increase the ability of PSOs to detect listed species. The applicant will also submit an alternative monitoring plan to ensure the ability to maintain exclusion zones during visibility conditions. Further, PAM would provide an additional means of detecting vocalizing marine mammals that are not visible at the surface. In addition, BOEM is evaluating the following mitigation and monitoring measures to address impacts on marine mammals, as described in detail in Table H-2 of Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

- Use long-term PAM buoys or autonomous PAM devices;
- Implement pile-driving noise-reduction technologies to achieve a reduction of noise;
- Implement a pile driving monitoring plan;
- Monitor pile-driving noise pursuant to an approved sound field verification plan (as described in Measure 31 in Table H-2 in Appendix H) to ensure compliance with required noise reductions and consistency with modeled noise attenuation estimates;
- Enlarge exclusion zones based on field measurements, if necessary, to reduce risk of exposure of marine mammals to injurious levels of noise;

- Conduct daily pre-construction surveys to ensure that marine mammals and sea turtles are not present in the area during pile driving;
- Use a real-time PAM system to monitor for NARW presence;
- Use PSOs to establish and maintain marine mammal clearance zones prior to and during pile-driving activities;
- Implement pile-driving time-of-year restrictions to avoid pile driving during the time of year with the greatest potential risk to NARW;
- Implement pile driving time-of-day restrictions to ensure adequate visibility during required monitoring of clearance zones;
- Implement shut-down and power-down procedures when marine mammals are detected in the exclusion zone;
- Implement enhanced time-of-year shut-down and restart procedures;
- Conduct daily and weekly reporting of marine mammals observed, if any, during pile-driving operations; and
- Use PSOs on proposed Project vessels to enhance detection of marine mammals and reduce risk of vessel strike.

As discussed in Section 3.7.2.1, marine mammals would be able to hear the continuous underwater noise of operational WTGs. Given the range of SPLs produced by operational WTG and the dependency of the SPLs on the WTG type and wind speed (Tougaard et al. 2020), operational noise could be slightly higher than ambient noise, which ranged from 95 to greater than 104 dB re 1 µPa in the waters near the RI/MA Lease Areas from 2011 to 2015 (Kraus et al. 2016a). However, sound levels are expected to be comparable to or lower than sound levels within 1 kilometer (0.6 mile) of commercial vessel noise (Tougaard et al. 2020). Additionally, studies suggest marine mammal species may use the wind farm for foraging, following prey species that are attracted to the foundations (Scheidat et al. 2011; Russell et al. 2014). Marine mammals in the SWDA are not expected to avoid the area (Mikkelsen et al. 2013; Russel et al. 2014) throughout the operational life of the proposed Project. Phase 1 WTG noise would, therefore, be expected to result in **negligible** impacts on marine mammals.

Decommissioning of the WTGs and ESPs is anticipated to have the same sequence and timeframe but in reverse of construction. Decommissioning impacts not generated during construction would include underwater noise emitted from underwater acetylene cutting torches, mechanical cutting, high-pressure water jet, and vacuum pump. SPLs are not available for these types of equipment but are not expected to be higher than construction vessel noise (generally between 150 and up to 180 dB re 1 µPa [Pangerc et al. 2016]). The applicant would return the sediments previously removed from the inner space of the pile to the depression left after the pile is removed. In addition, the applicant would likely use a vacuum pump and diver or ROV-assisted hoses to minimize sediment disturbance and turbidity. The applicant may abandon the offshore export cables in place, in which case there would be no impacts from their decommissioning. If required, the applicant would remove the cables from their embedded position in the seabed. Where necessary, the applicant would jet plow the cable trench to remove the sandy sediments covering the cables and reel the cables onto barges. Seabed surveys where offshore facilities were located would be conducted to verify site clearance.

Although some of the decommissioning activities (e.g., acoustic impacts and increased levels of turbidity) may cause marine mammals, including listed species, to avoid or leave the area, this disturbance would be short term and temporary. The increased vessel traffic associated with decommissioning could also cause a temporary increase in potential impacts, including vessel strike risk. An increase in underwater noise as a result of decommissioning construction activities, vessel traffic, and site clearance verification surveys is expected but would remain localized and temporary. Details regarding potential impacts on listed species are found in the proposed Project BA (BOEM 2022d). As a result, the impacts of Phase 1 decommissioning noise on marine mammals would be **minor**, with populations fully recovering following decommissioning activities.

Port utilization: A number of existing ports would be used by proposed Project vessels throughout the duration of construction and operations activities of Phase 1 (COP Volume 1, Section 3.2.2.5; Epsilon 2022a). However, Phase 1 of the proposed Project does not include implementing any port upgrades or modifications (COP Volume 1, Section 3.2.2.5; Epsilon 2022a). As no port expansion activities are considered, Phase 1 would not be anticipated to cause impact on marine mammal populations. Impacts on marine mammals would, therefore, be **negligible**.

Vessel activity (and, therefore, port utilization) associated with Phase 1 operations would be less than the levels described for construction; therefore, Phase 1 port utilization impacts on marine mammals would be **negligible**. Impacts from decommissioning would be similar to those for construction and would, therefore, be **negligible** for Phase 1

Presence of structures: The various types of impacts on marine mammals that could result from the presence of structures are described in detail in Section 3.7.2.1. There could be up to approximately 18,468 acres of structures and associated scour protection, as well as new hard protection (Table E-1). Of this area, only 108 acres would result from the proposed Project, and the remainder would result from other offshore wind projects in the geographic analysis area. Of the estimated 2,955 structures, up to 63 would result from Phase 1. The structures and scour/cable protection and the potential impacts would remain at least until decommissioning of each facility is complete (30 years). The presence of new structures could result in a localized increase of prey items for some marine mammal species at individual WTG foundations. However, the impacts of changes to oceanographic conditions caused by the presence of offshore structures on marine mammal prey species and, therefore, marine mammals are not known at this time, and they are likely to vary seasonally and regionally. Structures associated with the proposed Project would provide some level of artificial reef effect as a result of changes to surface currents, local mixing, and primary productivity and may result in long-term and **minor** beneficial impacts on seals and small odontocete foraging and sheltering. However, long-term and **minor** adverse impacts could occur as a result of increased interaction with active or ghost fishing gear. Bottom tending mobile gear is more likely to be displaced than fixed gear; as such, gear associated with sink gill nets and lobster pots has the potential to affect marine mammals. BOEM has determined that the potential for displacement of fixed gear from the geographic analysis area is low due to the gear able to be deployed in a fixed location. There is the potential that sink gill net effort, in the short term, could shift into the geographic analysis area if catch is higher around wind turbine foundations. However, this impact is anticipated to be short term (1 to 2 years) and would have **minor** impacts on marine mammals.

While the significance level of impacts would remain the same, BOEM is evaluating the following mitigation and monitoring measure to address impacts on marine mammals, as described in detail in Table H-2 of Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

- Require periodic underwater surveys and monofilament line and other fishing gear cleanup efforts around WTG foundations.

This would remove any identified fishing gear and reduce the potential for impacts on marine mammals 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 of uncertainty around large whale response to offshore wind facilities due to the novelty of this type of development on the Atlantic OCS. Monitoring studies would be able to determine more precisely any changes in whale behavior. Based on the best available information, no changes are anticipated. However, long-term, intermittent, and **minor** impacts on foraging, migratory movements, or other important behaviors may occur as a result of Phase 1. Additionally, temporary displacement from the SWDA during proposed Project construction into areas with higher risk of interactions with fishing and commercial vessels (see traffic IPF below) may also contribute to impacts on marine mammals.

Traffic: With respect to ship strike risk, the applicant estimates that an average of approximately 30 vessels and up to a maximum of approximately 60 vessels could operate simultaneously within the SWDA or OECC during the proposed Project's most active construction period (COP Volume III 7.8). The maximum number of vessels involved in the proposed Project at any one time is highly dependent on the final schedule, final design of its components, and the logistics solution used to achieve compliance with the Jones Act. 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, and other baleen whales and their calves that spend considerably more time at/near the ocean surface. Based on a USCG analysis of AIS data for 2015 through 2018, 13,000 to 46,900 vessel transits occur annually in the wind energy areas and surrounding region, with vessel density in the wind energy areas is up to four times higher during the summer months than during the winter months (USCG 2020). The majority of traffic occurs outside the RI/MA Lease Areas. Within the SWDA, AIS data indicate relatively low vessel traffic levels, averaging 862 unique vessel tracks annually transiting the SWDA from 2016 through 2019 (COP Volume III, Section 7.8; Epsilon 2022a). Vessel density within the OECC is likewise relatively low (63 to 73 AIS-equipped vessels per day on average), with the highest concentration of traffic midway through Nantucket Sound (COP Volume III, Section 7.8; Epsilon 2022a). Vessel traffic along the OECC is also highly seasonal, with up to 200 to 300 vessels per day during peak summer months (July and August). These data, however, only represent vessels equipped with AIS, which is generally limited to vessels greater than 20 meters (65 feet). Existing vessel traffic within the SWDA and OECC is further described in the NSRA provided in COP Appendix III-I (Epsilon 2022a). Phase 1 is expected to contribute an average of 7 and up to 15 proposed Project-related vessels during peak months of activity within the OECC (COP Appendix III-I; Epsilon 2022a). The highest proposed Project-related vessel activity within the SWDA and OECC would occur during peak construction. No significant disruption of normal traffic patterns is anticipated in the SWDA associated with the proposed Project. Although Phase 1 would result in an increase in regional vessel traffic above historical baseline averages, a significant increase the overall risk of vessel collisions is not expected due to the implementation of mitigation and monitoring measures (Appendix H).

The applicant anticipates that WTG and ESP components, as well as offshore export cables, would be shipped from Canadian and European ports, either directly to the SWDA or through a U.S. port. A total of approximately 936 vessel round trips, with approximately 39 round trips per month, are anticipated over the 2-year construction schedule (COP Appendix III-I; Epsilon 2022a). These estimates are based on the installation of up to 63 foundations (including up to 2 ESPs, with the remainder for WTGs) during Phase 1 and represent the maximum-case scenario. These vessels would follow the major navigation routes and make similar trips to U.S. ports in the absence of Phase 1 (Michael Clayton, Pers. Comm., July 23, 2020).

Temporary and/or permanent increases in vessel traffic outside of the SWDA may also occur due to displacement of commercial and recreational fishing vessels. Bottom tending mobile gear is more likely to be displaced from the wind development areas than fixed gear.

Environmental surveys to monitor impacts of Alternative B (including Phase 1) on marine mammals would contribute to vessel traffic in and near the SWDA. Treatment sites and control sites would be monitored before and after construction using the following typical methodologies:

- Benthic grab sampling and analysis;
- Sediment profile imaging acquisition and processing;
- High-resolution multibeam depth sounding and video survey;
- Trawl survey for finfish and squid;
- Ventless trap survey;
- Plankton survey; and
- Optical survey (drop-camera) of benthic invertebrates and habitat.

Vessel strike is one of the primary causes of NARW deaths, 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). Phase 1 includes measures the applicant has committed to voluntarily implement to reduce the potential for vessel strikes of listed species, including the NARW. Added vessel traffic and use of nets and towed gear for biological sampling is associated with risk of vessel allision/collision and entanglement.

While the significance level of impacts would remain the same, BOEM could reduce impacts by requiring as a condition of COP approval that the applicant implement the mitigation, monitoring, and reporting requirements proposed by the applicant; the mandatory reasonable and prudent measures included in the proposed Project-specific ITS issued by NMFS under the ESA and the conditions required in the LOA to be issued by NMFS under the MMPA. These would include requirements for vessel strike avoidance procedures and protected species reporting to ensure vigilance by vessel crews during transit; requirement for vessel observers to monitor a vessel strike avoidance zone around project vessels; and use of AIS to monitor the number of proposed Project vessels, traffic patterns, and vessel compliance with required speed restrictions (COP Volume I, Section 6.7.4; Epsilon 2022a).

Given the implementation of proposed Project-specific measures discussed above, vessel strikes as a result of Phase 1 are unlikely, and impacts on marine mammal individuals through this IPF would be **minor**; as such, no population-level impacts would be expected.

Impacts of Phase 2

Impact levels from IPFs during Phase 2 are expected to be similar to those of Phase 1 with similar construction, operations, and decommissioning methods and techniques. However, if each phase is fully built using the maximum design scenario for each, impacts on marine mammals would be marginally greater during Phase 2 than Phase 1 due to the larger number of foundations. If the applicant includes the SCV as part of the final proposed Project design, some or all of the impacts on marine mammals from the Phase 2 OECC through Muskeget Channel would not occur. BOEM will provide a more detailed analysis of the impacts of the SCV and the Phase 2 OECC on marine mammals in a supplemental NEPA analysis.

Phase 2 operations would require routine, preventative maintenance, and equipment inspections equivalent to Phase 1 (COP Volume III, Section 4.3.2; Epsilon 2022a). The maximum-case scenario for Phase 2 includes 400 nautical miles (460 miles) of offshore export, inter-array, and inter-link cables (Appendix III-T; Epsilon 2022a), which represents an increase of 159 nautical miles (182 miles) of cable compared to Phase 1. However, impacts on marine mammals during Phase 2 operations are not anticipated to be appreciably different from Phase 1 and, therefore, would be the same as for the

Phase 1 operations. Under the maximum-case scenario for the Phase 2 SCV, routine maintenance, preventative maintenance, and equipment inspections would still occur, but overall impacts on marine mammals are not likely to appreciably differ from OECC cables routed through Muskeget Channel alone.

Phase 2 decommissioning is anticipated to be the same sequence and timeframe but in reverse of construction and would require the removal of all proposed Project components, including foundations, cables, fluids, and chemicals (COP Volume III, Section 4.3.3; Epsilon 2022a). The process is expected to be equivalent to Phase 1 decommissioning. Impacts on marine mammals during Phase 2 decommissioning, including the SCV, are not anticipated to be appreciably different from Phase 1 and would be the same as for Phase 1 decommissioning. The impact determinations for IPFs associated with Phase 2 decommissioning, inclusive of the SCV, would not change or would be greatly reduced for marine mammals compared to Phase 2 construction.

Accidental releases: The incremental impacts of Phase 2 from accidental releases of hazardous materials and trash/debris would be the same as Phase 1. Because Phase 1 would be operational during construction of Phase 2, impacts of accidental releases during Phase 2, including the SCV, would have the same impacts as Phase 1 and would remain **negligible**.

Cable emplacement and maintenance: The maximum design scenario for Phase 1 states that 442 acres of seafloor would be disturbed as a result of cable installation and dredging prior to cable installation in the SWDA and OECC (COP Appendix III-T; Epsilon 2022a). Under the maximum-case scenario for Phase 2, 732 acres of seafloor would be disturbed, or 290 more acres than Phase 1. Under the maximum-case scenario for the Phase 2 SCV, up to 629 acres of bottom disturbance would occur within federal waters in addition to Phase 2 OECC routed through Muskeget Channel (Epsilon 2022a). Phase 2 and Phase 2 SCV would result in elevated turbidity with the potential for temporary impacts on some marine mammal prey species. However, elevated turbidity levels would be short term, temporary, and localized. Although modeling results indicate a slightly larger area of impact for the Phase 2 SCV when compared to the OECC route through Muskeget Channel (Epsilon 2022a), it is unlikely to differentially impact marine mammals. The impacts from cable emplacement and maintenance as a result of Phase 2, including the SCV, would not be expected to be greater than those discussed for Phase 1 and would remain **negligible**.

Climate change: The impacts from climate change on marine mammals would be the same for Phase 2 as for Phase 1. In the context of environmental trends, the combined impacts from this IPF from ongoing and planned activities, including Phase 1, Phase 2, and Phase 2 SCV, remain uncertain and difficult to predict with certainty but would be anticipated to qualify as **minor** to **moderate**. Future offshore wind development would not be expected to contribute to climate change impacts on marine mammals.

Noise: Noise generated during Phase 2 (inclusive of the Phase 2 OECC SCV option) from construction, impact and vibratory pile driving, drilling, potential UXO detonations, G&G survey activities, aircraft, cable laying, operations, and vessel traffic could contribute to impacts on marine mammals. The SCV option would shift the location of noise-producing activities but is not expected to differentially impact marine mammals. The noise with the greatest impact is expected to come from impact (impulsive) pile driving. Up to 89 foundations (including up to 3 ESPs, with the remainder for WTGs) would be installed during Phase 2, which could include three foundation types: monopiles, jackets, or bottom-frame foundations, all of which would be installed using impact pile driving. A 13-meter monopile foundation is included in the Phase 2 PDE, representing the maximum monopile diameter that may be installed during Phase 2; the maximum hammer energy for monopile installation is 6,000 kJ. Acoustic modeling indicates similar results between the 12-meter and 13-meter monopiles when installed with the same hammer energy (COP Appendix III-M; Epsilon 2022a); exposure ranges for 13-meter monopile foundations using 6,000 kJ hammer energy were estimated using mathematical scaling rather than a full model to estimate mitigation zones that accommodate this design possibility while ensuring the protection of marine mammals (JASCO 2022). The Phase 2 PDE also includes the 12-meter monopile and 4-meter jacket pile foundation types used for Phase 1. A bottom-frame foundation may also be used during Phase 2, which would have the same 4-meter maximum pile diameter as the jacket foundation, but with shallower penetration. Although the bottom-frame foundation was not modeled separately, it is assumed that the potential acoustic impact would be equivalent to or less than that predicted for the jacket foundation (COP Appendix III-M; Epsilon 2022a).

Due to the temporary, localized nature of noise produced by impact pile driving under Phase 2, avoidance of peak seasons of NARW occurrence, and the implementation of extensive mitigation and monitoring measures described in the COP (Volume III, Section 6.7.4; Epsilon 2022a), risk of exposure to above-threshold noise levels is expected to be minimized. The impacts of pile driving for bottom-frame foundations would be similar to those described for jacket foundations (COP Appendix III-M; Epsilon 2022a). Further, impacts of 12-meter and 13-meter monopile installation are similar, although the 13-meter monopile would result in slightly larger exposure ranges for the same hammer energy (JASCO 2022). The difference in exposure ranges between 12-meter and 13-meter monopiles would not result in a substantially greater risk of impact on marine mammals, and the impact on marine mammals from noise exposure is not expected to differ if the applicant includes the SCV as part of the final proposed Project design. Additionally, construction of Phase 2 would occur after construction of Phase 1 has been completed rather than occurring concurrently, so it would not be expected to result in any additive risk to marine mammal species. Therefore, impacts from Phase 2 would be the same as under Phase 1 and would remain **moderate** overall due to pile-driving activities. Noise from cable-laying activities is expected to result in temporary and **minor** impacts on marine mammals. Vessel noise during construction is anticipated to be **moderate** for all mysticetes and **minor** for all other marine mammals. G&G survey noise and noise associated with aircraft is expected to remain **negligible**. Similar to Phase 1, no population-level impacts are expected.

Port utilization: A number of existing ports would be used by proposed Project vessels throughout the duration of Phase 2 construction and operations activities (COP Volume 1, Section 4.2.2.5; Epsilon 2022a). Vessel traffic and port utilization during construction of Phase 2 is expected to remain the same as under Phase 1; therefore, impacts on marine mammals would remain **negligible**. If the applicant includes the SCV as part of the final proposed Project design, different ports may be used, but impacts on marine mammals are not likely to differ.

Presence of structures: Phase 2 would add up to 89 foundations (of which up to 3 would be for ESPs, with the remainder for WTGs). The number of foundations would be the same if the Phase 2 SCV is implemented. Impacts on marine mammals would remain the same for Phase 2 as Phase 1. Structures installed during Phase 2 would provide some level of reef effect and may result in long-term and **minor** beneficial impacts on seal and small odontocete foraging and sheltering, though long-term and **minor** adverse impacts could occur as a result of increased interaction and entanglement with active or ghost fishing gear. If a requirement to remove any abandoned fishing gear from WTG foundations is imposed during Phase 2 as suggested for Phase 1, the potential for impacts on marine mammals would be reduced to **negligible** levels. Long-term, intermittent, and **minor** impacts on foraging, migratory movements, or other important behaviors may also occur as a result of Phase 2, though there remains a large degree of uncertainty around large whale response to offshore wind facilities in the Atlantic.

Traffic: The expected vessel types and amount of vessel traffic during Phase 2 construction is expected to remain the same as or similar to that under Phase 1. Although Phase 2 would result in an increase in regional vessel traffic above historical baseline averages, this is not expected to result in a significant increase the overall risk of vessel collisions, particularly with the proposed mitigation and vessel strike avoidance measures the proposed Project would employ. Given the implementation of proposed Project-specific vessel strike avoidance measures, vessel strikes as a result of Phase 2 are unlikely, and impacts on marine mammal individuals through this IPF would remain **minor** with no population-level impacts expected. Under the maximum-case scenario for the Phase 2 SCV, additional vessel traffic may shift westward, but overall impacts on marine mammals are not likely to appreciably differ from OECC cables routed through Muskeget Channel alone.

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-4 in Appendix G would contribute to impacts on marine mammals through the primary IPFs of noise and the presence of structures. These impacts would primarily occur through pile driving and other sources of noise during construction, as well as change in habitat due to the presence of offshore structures. The cumulative impacts of all IPFs from ongoing and planned activities, including Alternative B, would be **moderate** and may include **moderate** beneficial impacts.

Conclusions

Impacts of Alternative B. Construction, operations, and decommissioning of Phase 1 and Phase 2, including Phase 2 SCV, would have **negligible** to **moderate** adverse impacts and could potentially include **minor** beneficial impacts on marine mammals. Adverse impacts are expected to result mainly from noise, specifically pile driving, UXO detonations, and traffic. Beneficial impacts are expected to result from the presence of structures and their associated artificial reef effect.

The impacts of Alternative B were similarly addressed for ESA-listed marine mammal species in the NMFS BA(BOEM 2022d). The effects determinations provided in the BA reflect BOEM's current understanding and will be finalized during the course of ESA consultation with NMFS. Table 3.7-12 summarizes the effects determinations for the listed marine mammals present within the geographic analysis area based on the analysis provided in the BA (BOEM 2022d) using the following definitions:

- **No Effect**: This is the appropriate determination when the action agency determines its Proposed Action is not expected to affect listed/proposed species or designated/proposed critical habitat.
- **May Affect, Not Likely to Adversely Affect**: This is the appropriate determination when effects on listed species are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are beneficial effects without any adverse effects. Insignificant effects relate to the size of the impact; the impact cannot be meaningfully detected, measured, or evaluated and should never reach the scale where take occurs. Discountable effects are those that are extremely unlikely to occur.
- **May Affect, Likely to Adversely Affect**: This is the appropriate determination when adverse effects that are not beneficial, insignificant, or discountable are likely to occur to listed species/critical habitat.

Table 3.7-12: Summary of Impacts Determination for Alternative B from the National Marine Fisheries Service Biological Assessment

Activity	Impact Type (IPF)	Potential Effect	Listed Whales[a]
Construction			
Inter-array and offshore export cable installation	Turbidity (presence of structures)	Foraging/prey availability	Not likely to adversely affect
Offshore export and inter-array cable installation, WTG installation	Benthic habitat loss (presence of structures)	Foraging/prey availability	Not likely to adversely affect
Steel anchor cables used on construction barges	Entanglement (presence of structures)	Injury/mortality	NA
Impact pile driving	Noise	PTS, behavioral disturbance	Likely to adversely affect: NARW and fin Not likely to adversely affect: Sei and sperm

Activity	Impact Type (IPF)	Potential Effect	Listed Whales[a]
Vibratory pile driving	Noise	PTS, behavioral disturbance	Not likely to adversely affect
Vessel traffic	Noise	PTS, behavioral disturbance	Not likely to adversely affect
	Strike (traffic)	Injury/mortality	Not likely to adversely affect
Operations			
WTG	Noise	PTS, behavioral disturbance	Not likely to adversely affect
	Accidental releases	Physiological impacts, inhalation, surfacing in the sheen	Not likely to adversely affect
	Lighting	Photoperiod disruption, attraction	NA
	Presence of structures	Habitat alteration	Not likely to adversely affect
Offshore export and inter-array cables	EMF	Impacts on orientation, migration, navigation	Not likely to adversely affect
Vessel traffic	Noise	PTS, behavioral disturbance	Not likely to adversely affect
	Strike (traffic)	Injury/mortality	Not likely to adversely affect
Decommissioning			
Removal of offshore export cable, WTG, and scour protection	Turbidity/benthic habitat loss (presence of structures)	Foraging/prey availability	Not likely to adversely affect
Vessel traffic	Noise	Behavioral disturbance	Not likely to adversely affect
	Strike (traffic)	Injury/mortality	Not likely to adversely affect
HRG and ROV for site clearance	Noise	PTS, behavioral disturbance	Not likely to adversely affect

EMF = electromagnetic fields; HRG = high-resolution geophysical; IPF = impact-producing factor; NA = not applicable; NARW = North Atlantic right whale; PTS = permanent threshold shift; ROV = remotely operated vehicle; WTG = wind turbine generator

[a] This includes NARW, fin whales, sei whales, and sperm whales.

Cumulative Impacts of Alternative B. Cumulative impacts on marine mammals in the geographic analysis area would range from **negligible** to **moderate** and may potentially include **minor** beneficial impacts to some marine mammal species due to the reef effect. Considering all the IPFs together, the impacts from ongoing and planned activities, including Alternative B, would result in overall **moderate** impacts on marine mammals in the geographic analysis area, primarily related to pile-driving, vessel, and construction noise; increased vessel traffic associated with other offshore wind projects; and ongoing climate change. Alternative B would contribute to the overall impact rating primarily through noise- and traffic-related IPFs. Thus, the overall impact on marine mammals from Alternative B in combination with other environmental trends and planned activities would likely be **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. Cumulative impacts would only occur where the activities of Alternative B overlap with other ongoing or planned activities (i.e., within the SWDA and OECC).

While the significance level of impacts would remain the same, as discussed above, BOEM is evaluating mitigation and monitoring measures to address impacts on marine mammals, as described in detail in Table H-2 of Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval.

3.7.2.4 Impacts of Alternative C – Habitat Impact Minimization Alternative on Marine Mammals

Alternatives C-1 and C-2 would reduce impacts on complex fisheries habitats compared to impacts of Alternative B through minor adjustments in the OECC route to avoid habitat for cod and other habitats. All other proposed Project components including construction, operations, and decommissioning would be identical to those of Alternative B.

Under these alternatives, the changes in the OECC from Alternative B could result in slightly decreased impacts on marine mammals during construction, operations, and decommissioning due to a decrease in area of disturbance in complex habitat areas. This lessens associated impacts from cable emplacement and maintenance, noise, and presence of structures. The degree of impact reduction would be directly related to the extent of complex habitat avoided in either the Western Muskeget Variant (Alternative C-1) or Eastern Muskeget route (Alternative C-2). Because the change in impacts on complex habitats relative to Alternatives C-1 and C-2 are expected to be **negligible**, impacts on marine mammals from each IPF would be the same as described for Alternative B (Section 3.7.2.3).

In the context of environmental trends and planned activities, Alternatives C-1 and C-2 would occur within the same overall environment (e.g., ongoing and actions). Therefore, impacts would only vary if the alternatives' incremental contributions differ (i.e., significant reduction). Although incremental impacts from Alternative C-1 and C-2 are expected to be similar to those of Alternative B Phase 1 and Phase 2, the overall impact, when combined with previous, ongoing, and future actions, would be **moderate**.

3.8 Sea Turtles

3.8.1 Description of the Affected Environment

3.8.1.1 Geographic Analysis Area

This section discusses existing sea turtles in the geographic analysis area, as described in Table D-1 in Appendix D, Geographical Analysis Areas, and shown on Figure 3.8-1, namely, 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. Table G.1-5 in Appendix G, Impact-Producing Factors Tables and Assessment of Resources with Minor (or Lower) Impacts, summarizes the existing conditions and the anticipated impacts, based on IPFs assessed, of ongoing and future offshore activities other than offshore wind, which is discussed below.

3.8.1.2 Existing Conditions

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 sea turtles (*Eretmochelys imbricata*). All these sea turtle species are migratory and occur in New England waters primarily in the summer and fall. Hawksbill sea turtles typically prefer topical habitats, and sightings are rare north of Florida, though there are few historical records as far north as Massachusetts, most recently as 1999 (NMFS and USFWS 1993; MGEL 2022). Therefore, hawksbill sea turtles are not likely to occur in the geographic analysis area, and this EIS does not consider them further. The other species may use the proposed Project area for travel, foraging, diving at depth for extended periods, and possibly for extended rest periods on the seafloor (COP Volume III, Section 6.8; Epsilon 2022a). Targeted surveys have been conducted for sea turtles near the proposed Project area, and the results can be found in the *Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles* (Kraus et al. 2016a), *Megafauna aerial surveys in the wind energy areas of Massachusetts and Rhode Island with emphasis on large whales: Summary Report Campaign 5, 2018-2019* (O'Brien et al. 2021a), *and Megafauna aerial surveys in the wind energy areas of Massachusetts and Rhode Island with emphasis on large whales: Interim Report Campaign 6A, 2020* (O'Brien et al. 2021b). A more detailed discussion regarding aspects of sea turtles potentially affected is available in the BA for the proposed Project (BOEM 2022d).

The combination of sightings, strandings, and bycatch data provides the best available information on sea turtle distribution in the SWDA. This section summarizes data from the most current sightings surveys of the waters around the RI/MA Lease Areas including the SWDA (Kraus et al. 2016a; O'Brien et al. 2021a, 2021b), the NMFS Sea Turtle Stranding and Salvage Network (NMFS 2021h), most recent available density estimates (COP Appendix III-M; Epsilon 2022a), and historic regional data (Kenney and Vigness-Raposa 2010). Table 3.8-1 summarizes sea turtle occurrence in the SWDA surrounding waters. Prey items vary with species, and detailed foraging information is provided in the BA for the proposed Project (BOEM 2022d).

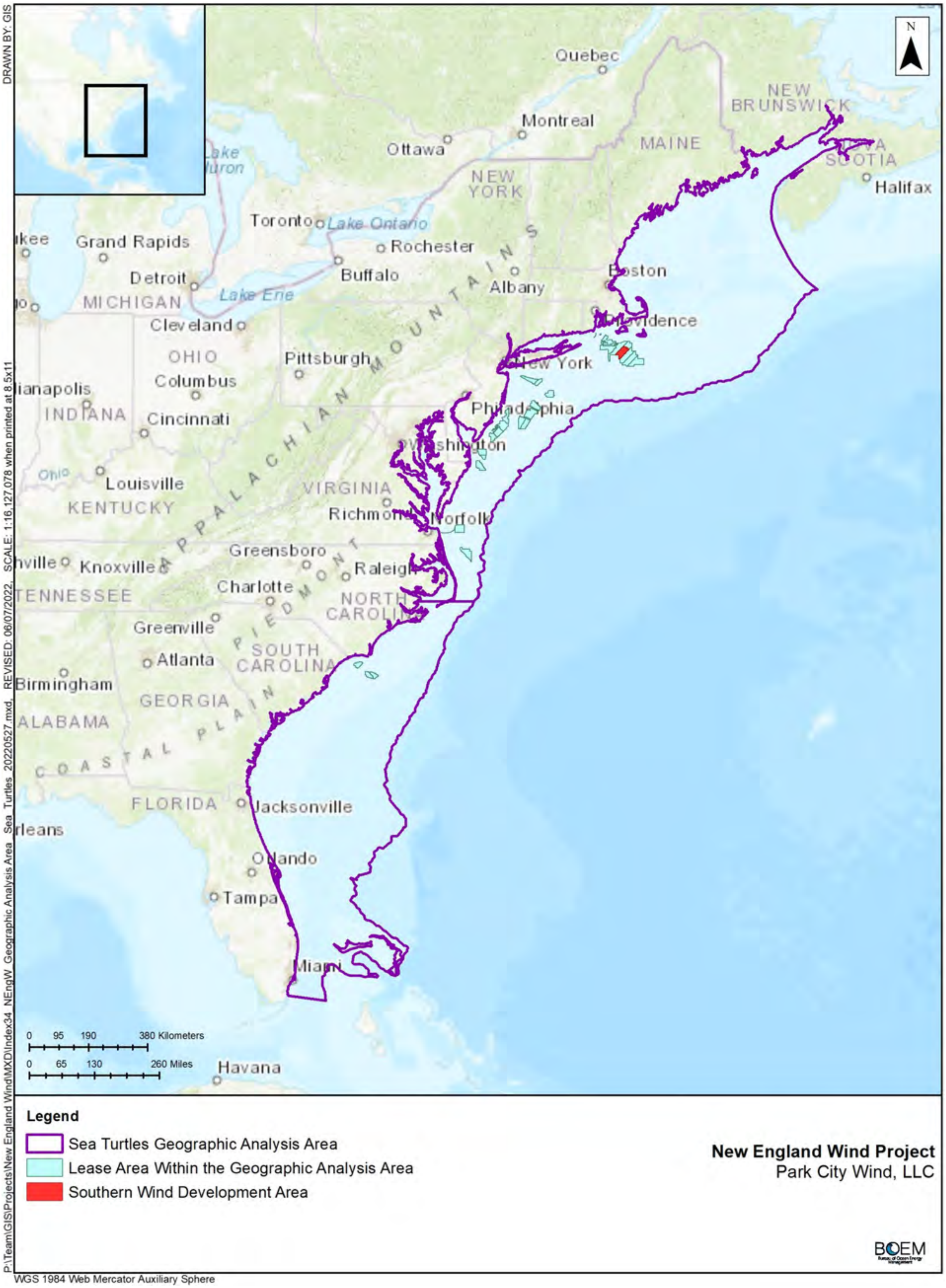


Figure 3.8-1: Geographic Analysis Area for Sea Turtles

Table 3.8-1: Summary of Sea Turtles Likely to Occur in the Coastal Waters in the Southern Wind Development Area and Surrounding Waters

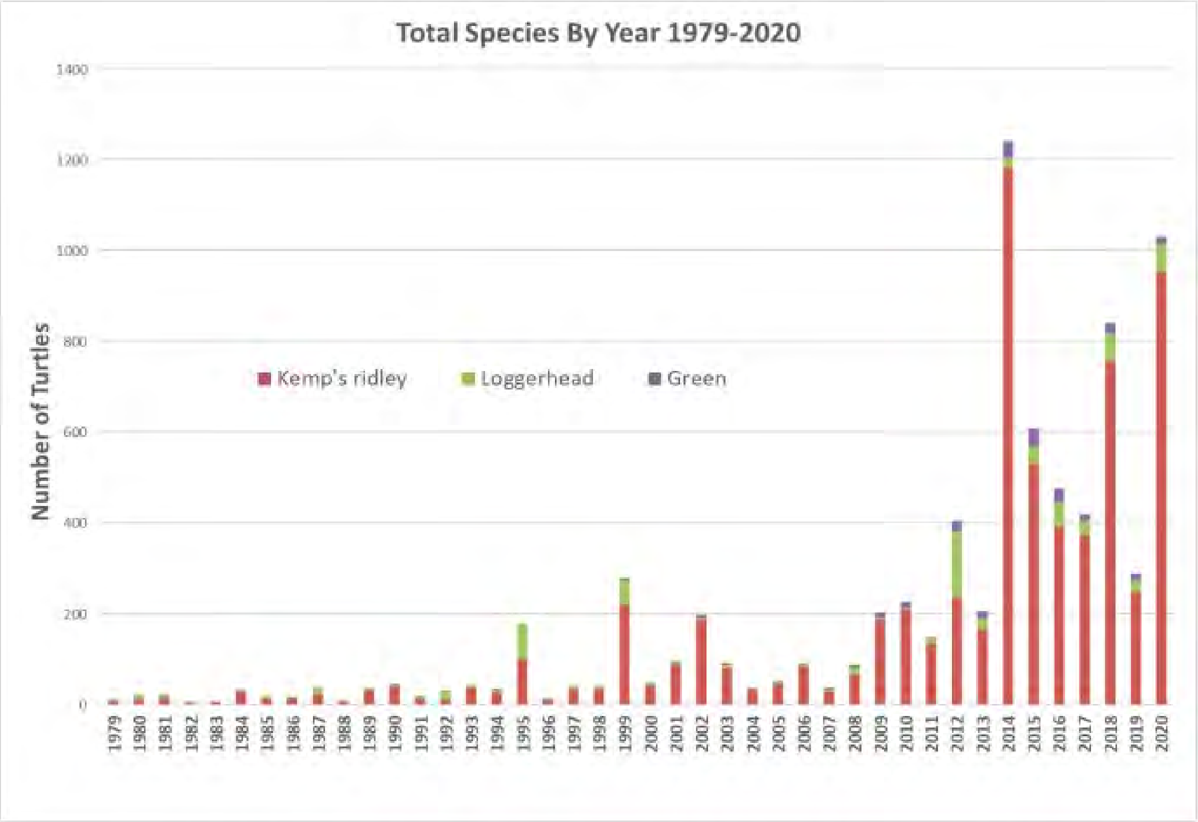
Common Name	Scientific Name	DPS or Population	ESA Status (Massachusetts ESA Status)	Relative Occurrence in the SWDA and Surrounding Waters
Green sea turtle	*Chelonia mydas*	North Atlantic DPS	Threatened (Threatened)	Rare
Hawksbill sea turtle	*Eretmochelys imbricata*	Atlantic	Endangered (Endangered)	Historical
Kemp's ridley sea turtle	*Lepidochelys kempii*	NA	Endangered (Endangered)	Regular (summer and fall)
Leatherback sea turtle	*Dermochelys coriacea*	Atlantic	Endangered (Endangered)	Common (summer and fall)
Loggerhead sea turtle	*Caretta caretta*	Northwest Atlantic DPS	Threatened (Threatened)	Common (summer and fall)

Source: Adapted from COP Volume III; Epsilon 2022a

DPS = distinct population segment; ESA = Endangered Species Act; NA = not applicable; SWDA = Southern Wind Development Area

[a] Species is listed as regular due to the lack of survey-based sightings (Kenney and Vigness-Raposa 2010).

Figure 3.8-2 shows strandings data for Cape Cod Bay (WBWS 2022). The Northeast Fisheries Observer Program statistical area 537 encompasses the waters from the southern shores of Martha's Vineyard and Nantucket south (including the SWDA and OECC) to the OCS waters off New York (NMFS 2022a). NMFS bycatch data in this area indicated that a total of 33 sea turtles (4 leatherback, 2 green, 21 loggerhead, and 6 unidentified hard-shelled turtles [i.e., unidentified members of Cheloniidae family]) were incidentally caught in monkfish, squid, and skate fishery gear from 2008 through 2021 (NMFS 2022a). These data under-represent the actual number of bycaught turtles due to the limited observer coverage for each fishery. The turtles were caught from June through December, with the majority in July (18 of 31) and August (5 of 31). In area 538, which includes the waters from the south shore of Cape Cod to the southern shores of Martha's Vineyard and Nantucket (and the OECC), one loggerhead turtle was incidentally caught in August 2014 (NMFS 2022a). No Kemp's ridley turtles were incidentally caught in either area from 2008 through 2021 despite the relatively high number of strandings in the area for this species. Interactions with sea turtles and fisheries gear in the SWDA are low compared to regional data.



Source: WBWS 2022

Figure 3.8-2: Sea Turtle Strandings by Year on Cape Cod reported by the Wellfleet Bay Wildlife Sanctuary from 1979 through 2020

Leatherback, loggerhead, and Kemp's ridley sea turtles have been sighted in the waters around the RI/MA Lease Areas, predominantly in the summer and fall (Kraus et al. 2016a; O'Brien et al. 2021a, 2021b). Leatherback (184 sightings) and loggerhead sea turtles (91 sightings) were the most commonly sighted species, occurring mostly during summer and fall, with a few sightings of both species in the spring (Kraus et al. 2016a; O'Brien et al. 2021a, 2021b). Kraus et al. (2016a) sighted a total of six Kemp's ridley sea turtles: one in August and five in September. Over their study period, Kraus et al. (2016a) observed 30 unidentifiable sea turtles, and O'Brien et al. (2021b) observed 1 unidentifiable sea turtle. Because of their high submergence rate and low profile at the sea surface, sea turtles can be difficult to see and identify to species during surveys, and the observed numbers in waters around the RI/MA Lease Areas are likely underestimated. There were no sightings of any species of sea turtle during the winter season. Although green sea turtles were not observed during any of the surveys, stranding records indicate the presence of green sea turtles in the area. Sightings per unit effort (SPUE) data from the Right Whale Consortium (2018) indicate similar trends in the seasonal occurrence for loggerhead, leatherback, Kemp's ridley, and unidentified sea turtles in the proposed Project area. Additional information on sea turtle occurrence in the proposed Project area is available in the BA for the proposed Project (BOEM 2022d).

Density estimates based on the most recent sightings data are not available for all sea turtles in the SWDA. Although density estimates for the geographic analysis area are limited, the COP (Appendix III-M; Epsilon 2022a) summarized seasonal estimates of sea turtle densities using data from the U.S. Navy Operating Area Density Estimate database (U.S. Navy 2007) and Kraus et al. (2016a) (Table 3.8-2). A detailed discussion of these density estimates can be found in the COP (Appendix III-M;

Epsilon 2022a). These estimates suggest that loggerhead and leatherback sea turtles are the most likely sea turtle species found in the proposed Project area, and their densities would be highest during summer and fall (Table 3.8-2; COP Appendix III-M; Epsilon 2022a).

Table 3.8-2: Sea Turtle Densities Estimates (Animals/100 Square Kilometers [38.6 Square Miles]) for the Southern Wind Development Area

Common Name	Scientific Name	Spring	Summer	Fall	Winter
Kemp's ridley sea turtle	*Lepidochelys kempii*	0.017	0.017	0.017	0.017
Leatherback sea turtle	*Dermochelys coriacea*	0.022	0.630	0.873	0.022
Loggerhead sea turtle	*Caretta caretta*	0.103	0.206	0.633	0.103
Green sea turtle	*Chelonia mydas*	0.017	0.017	0.017	0.017

Source: COP Volume III, Appendix M; Epsilon 2022a

3.8.1.3 Trends

Sea turtles are wide-ranging and long-lived, making population estimates difficult, and methods vary depending on species (TEWG 2007; NMFS and USFWS 2013, 2015a, 2015b). Since sea turtles have large ranges and highly migratory behaviors, the current condition and trend of sea turtles are affected by factors outside the geographic analysis area (BOEM 2014c, 2021a; NMFS 2020a). Data indicate that the nesting populations of leatherback and green sea turtles are generally stable or show some signs of increasing nesting trends (NMFS and USFWS 2013, 2015b; TEWG 2007). However, nesting populations of loggerhead and Kemp's ridley sea turtles have not reached critical benchmark recovery criterion or reduced nesting populations indicate the populations are not recovering (NMFS and USFWS 2015a, 2019; Ceriani et al. 2019).

All sea turtle species in the geographic analysis area are subject to pre-existing regional 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 or the hypothermic reaction that occurs when sea turtles are exposed to prolonged cold-water temperatures, causing a decreased heart rate, decreased circulation, and lethargy, followed by shock, pneumonia, and possibly death. In comparison, leatherback sea turtles have numerous physical and physiological adaptations for maintaining thermoregulation in cold-water temperatures, including a degree of endothermy (Eckert et al. 2012). While in the coastal waters in and near the proposed Project area, sea turtles may be found swimming, foraging, migrating, diving at depth for extended periods, basking at the surface (Spotila and Standora 1985), and possibly engaged in extended rest periods on the ocean bottom. All sea turtle species are susceptible to the impacts of vessel traffic, with potential impacts including behavioral modification from vessel noise and physical presence, and vessel strike. Sea turtles are known to orient to changes in EMF emitted from power cables, which are likely detectable by sea turtles at close ranges (Normandeau 2011); however, no impacts on sea turtles from the numerous submarine power cables around the world have been documented to occur (NMFS 2020a). There are no nesting beaches or other nearshore critical habitats for sea turtles in the geographic analysis area; therefore, potential impacts associated with onshore proposed Project components are not evaluated in this section.

Commercial fisheries in southeastern New England include bottom trawl, midwater trawl, dredge, gillnet, longline, and baited pots and traps (Eckert et al. 2012; COP Volume III, Section 7.6; Epsilon 2022a), all of which can impact sea turtles through entanglement and bycatch. More than 1,200 entangled sea turtles are encountered per year globally, with just over a 90 percent mortality rate (Duncan et al. 2017). Commercial vessel traffic in the region is variable depending on location and vessel type. The commercial vessel types and relative density in the proposed Project area during 2017 and 2018 include cargo (low), passenger (high), tug-tow (high), and tanker (low) (Section 3.13, Navigation and Vessel Traffic). This vessel traffic can injure and/or kill individual sea turtles due to vessel strikes.

3.8.2 Environmental Consequences

Definitions of potential impact levels for sea turtles are provided in Table 3.8-3.

Table 3.8-3: Impact Level Definitions for Sea Turtles

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations.
	Beneficial	Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations.
Minor	Adverse	Impacts on sea turtles would be detectable and measurable, but of low intensity, highly localized, and temporary or short term in duration. Impacts may include injury or loss of individuals, but these impacts would not result in population-level impacts.
	Beneficial	Impacts on sea turtles would be detectable and measurable, but of low intensity, highly localized, and temporary or short term in duration. Impacts could increase survival and fitness, but would not result in population-level impacts.
Moderate	Adverse	Impacts on sea turtles would be detectable and measurable and could result in population-level impacts. Adverse impacts would likely be recoverable and would not affect population or DPS viability.
	Beneficial	Impacts on sea turtles would be detectable and measurable and could result in population-level impacts. Impacts would be measurable at the population level.
Major	Adverse	Impacts on sea turtles would be significant and extensive and long term in duration, and could have population-level impacts that are not recoverable, even with mitigation.
	Beneficial	Impacts would be significant and extensive and contribute to population or DPS recovery.

DPS = distinct population segment

3.8.2.1 Impacts of Alternative A – No Action Alternative on Sea Turtles

When analyzing the impacts of Alternative A on sea turtles, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the existing conditions for sea turtles (Table G.1 5 in Appendix G). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for sea turtles described in Section 3.8.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles include undersea cables or pipelines, tidal energy projects, marine minerals projects, military activities, marine transportation, fisheries, oil and gas activities, onshore development, and global climate change. A description of these activities is provided in Appendix E. The impacts on sea turtles from these ongoing and future non-wind activities will continue and result in similar impacts regardless of offshore wind energy development. The rate and continuation of these events is uncertain, but their impacts on sea turtles would be detectable from changes in sea turtle behavior, migratory patterns, foraging activities, and evidence of population-level changes from ongoing survey data.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles include continued operation of the Block Island Wind Farm, as well as ongoing construction of Vineyard Wind 1 in OCS-A 0501 and the South Fork Wind Project in OCS-A 0517. Ongoing operation of the Block Island Wind Farm and ongoing construction of Vineyard Wind 1 and South Fork Wind Project, along with planned offshore wind activities, would affect sea turtles through the primary IPFs described below.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than Alternative B). Future offshore wind activities to affect sea turtles through the following primary IPFs.

Accidental releases: Accidental releases of fuel/fluids/hazardous materials, and/or trash and debris may increase as a result of future offshore wind activities. Section G.2.2, Water Quality, discusses potential releases. The risk of any type of accidental release would be increased primarily during construction when additional vessels are present, but also during operations, including maintenance operations, and decommissioning of offshore wind facilities.

Activities under Alternative A would carry a low risk of a leak of fuel/fluids/hazardous materials from any 1 of approximately 2,955 WTGs and ESPs in the geographic analysis area. Each WTG stores approximately 5,000 gallons of such materials, for a total of approximately 119 million gallons in the geographic analysis area. BOEM estimates that a release of 128,000 gallons is likely to occur no more often than once per 1,000 years, and a release of 2,000 gallons or less is likely to occur every 5 to 20 years (Bejarano et al. 2013). The likelihood of a spill occurring from multiple WTGs and ESPs at the same time is very low; therefore, the potential impacts from a spill larger than 2,000 gallons are largely discountable. Sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka et al. 2010; Shigenaka et al. 2021) or sublethal impacts on individual fitness, including adrenal impacts, dehydration, hematological impacts, increased disease incidence, liver impacts, poor body condition, skin impacts, skeletomuscular impacts, and several other health impacts attributed to oil exposure (Bembenek-Bailey et al. 2019; Camacho et al. 2013; Mitchelmore et al. 2017; Shigenaka et al. 2010, Shigenaka et al. 2021; Vargo et al. 1986). Accidental releases may impact sea turtles due to impacts on their prey species. 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. Ingestion of plastic fragments is well documented and has been observed in all species of sea turtles (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). In addition to plastic debris, ingestion of tar, paper, Styrofoam, wood, reed, feathers, hooks, lines, and net fragments have also been documented (Tomás et al. 2002). Ingestion can also occur when individuals mistake debris for potential prey items (Gregory 2009; Hoarau et al. 2014; Tomás 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 impacts more difficult to detect (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Long-term sublethal impacts 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 impacts are not well understood, and clear causal links are difficult to identify (Nelms et al. 2016). BOEM assumes all vessels would comply with laws and regulations such as those recommended by the International Convention for the Prevention of Pollution from Ships to minimize releases. 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. An accidental trash or debris release associated with offshore wind activity would be a localized event, and the amount released would likely be miniscule compared to other existing sources.

Anchoring and gear utilization: Ongoing and planned offshore wind activities are likely to include monitoring surveys in the offshore wind lease areas. These could include acoustic, trawl, and trap surveys, as well as other methods of sampling the biota in the area. The presence of monitoring gear could affect sea turtles by entrapment or entanglement; however, it is expected that monitoring plans would have sufficient mitigation procedures in place to reduce potential impacts. Impacts from gear utilization from other offshore wind activities on sea turtles are expected to occur at short-term, regular intervals over the lifetime of the projects and have no perceptible consequences to individuals or the population. However, the potential extent and number of animals potentially exposed cannot be determined without proposed Project-specific information.

Cable emplacement and maintenance: The impact on water quality from sediment suspension during cable-laying activities is expected to be temporary and short term. Under Alternative A, cable emplacement would disturb approximately 63,840 acres beginning in 2022 and continuing through 2030 and beyond. Data are not available regarding impacts 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 2021b). Sea turtles would swim through or away from sediment plumes. Elevated turbidity is most likely to temporarily affect the foraging behavior of sea turtles by attracting prey to feed on detritus or by interference with visual prey detection, but no impacts would occur due to swimming through the plume (NOAA 2021b). Turbidity associated with increased sedimentation may result in temporary, short-term impacts on some sea turtle prey species, including benthic mollusks, crustaceans, sponges, “sea pen” octocorals, and crabs. 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. Some impacts could occur if multiple projects occur in close temporal and spatial proximity, although these impacts would not be biologically significant. 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 Alternative A is low, and population-level impacts are unlikely to occur.

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 cause long-term, high-intensity risk to sea turtles, as well as changes to nesting periods, sex ratios of nestlings, and the elimination of potentially suitable habitat or access to potentially suitable habitat (Fuentes and Abbs 2010; Janzen 1994; Newson et al. 2009; Witt et al. 2010). Future offshore wind development would not contribute to climate change impacts on sea turtles. Appendix E discusses activities that contribute to climate change. Other future offshore wind projects would have beneficial impacts, although the combined offshore wind projects would still displace a small share of global emissions.

EMF: Sea turtles are known to possess geomagnetic sensitivity (but not electro sensitivity) used for orientation, navigation, and migration (Lohmann et al. 1997). Sea turtles appear to have a detection threshold of magnetosensitivity and behavioral responses to field intensities ranging from 0.0047 to 4,000 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 2011). Under Alternative A up to

6,552 miles 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 levels below what would be detectable by sea turtles. 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 regarding impacts on sea turtles from EMF generated by underwater cables, although anthropogenic magnetic fields can influence migratory deviations (Luschi et al. 2007; Snoek et al. 2016). Lohmann et al. (2008) speculated that navigation methods used by adult and juvenile sea turtles were dependent upon the stage of migration, initially relying on magnetic orientation**.** While the specific mechanisms of leatherback sea turtle navigation are not currently known, it is believed that they possess a compass sense similar to hardshell turtle species, possibly related to geomagnetic cues (Eckert et al. 2012; Luschi et al. 2007; NMFS and USFWS 2013). 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 2011), and no biologically significant impacts due to increased energy expenditure would be expected (BOEM 2022d). Heat transfer into surrounding sediment associated with buried submarine high-voltage cables is possible (Emeana et al. 2016). However, heat transfer is not expected to extend to any appreciable effect into the water column due to the use of thermal shielding, the cable's burial depth, and additional cable protection, such as scour protection or concrete mattresses for cables unable to achieve adequate burial depth, and heat transfer is not expected to have an appreciable effect on sea turtles.

Lighting: Offshore wind development would result in additional anthropogenic light from vessels and offshore structures at night. Artificial light pollution, particularly near nesting beaches is detrimental to sea turtles because it alters critical nocturnal behaviors; namely, their choice of nesting sites, their return path to the sea after nesting, and how hatchlings find the sea after emerging from their nests (Witherington et al. 2014). There are no records of sea turtle nesting within the geographic analysis area, so this discussion of the impacts of anthropogenic light sources on sea turtles within the geographic analysis area is limited to offshore sources and behaviors. Offshore anthropogenic light sources 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 dissipate once the vessel or the turtle has left the area.

Under Alternative A, up to 2,955 WTGs and ESPs would be constructed incrementally from 2022 through 2030 and beyond in the geographic analysis area, where few lighted structures currently exist. WTGs and ESPs would have minimal yellow flashing navigational lighting and red flashing FAA hazard lights in accordance with FAA (2020) and BOEM (2021a) lighting and marking guidelines (COP Volume I, Section 3.2.1; Epsilon 2022a). Available information neither confirms nor refutes the potential for WTG and ESP lighting to generate sufficient downward illumination to affect sea turtles; however, per BOEM (2021a) 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, juvenile leatherback sea turtles do not appear to be attracted to light (Gless et al. 2008). In addition, most juvenile leatherbacks, in contrast to loggerheads, either failed to orient or oriented at an angle away from the lights, although older, adult turtles might show responses that differ from those of juvenile turtles (Gless et al. 2008). 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 impacts on juvenile or adult sea turtles. Although the potential impacts of offshore lighting on juvenile and adult sea turtles are 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. This reflects the research described above, as well as the lack of evidence of impacts on sea turtles from decades of operations of offshore oil and gas platforms in the Gulf of Mexico, which can have considerably more lighting than offshore WTGs (BOEM 2022d). Further potential impacts arising from offshore lighting could be reduced through the use of ADLS on all offshore structures associated with offshore wind development.

Noise: Anthropogenic noise associated with Alternative A has the potential to impact sea turtles through potential auditory injuries; short-term disturbance including altered submergence patterns, 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 proposed Project impact pile driving, vibratory pile driving, aircraft, G&G surveys, cable laying, operational WTGs, and vessel traffic.

Noise from impact pile driving would occur during foundation installations for a total of 3,166 non-concurrent pile-driving days under the one-pile-per-day scenario or 1,522 non-concurrent pile-driving days under the two-piles-per-day scenario between 2022 and 2030 (Table 3.7-7). Sea turtles could be displaced up to 6 hours per day during monopile installation and up to 14 hours per day during jacket installation. However, given the restrictions on pile-driving activities that limit pile driving to daytime hours only, potential 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 have long-term impacts on sea turtles. Although information about the noise impacts of offshore wind construction 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. The magnitude of these impacts would depend upon the locations of concurrent construction, as well as the number of hours per day and the number of days that impact pile driving would occur and the time of year when impact pile driving is performed. Individuals repeatedly exposed to pile driving over a season, year, or life stage may incur energetic costs with potential long-term consequences (U.S. 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 some individuals have been shown to retain this habituation even when the repeated exposures were separated by several days (Bartol and Bartol 2011; U.S. Navy 2018).

Source levels for vibratory pile driving, expressed as SEL, have been measured between 175 to 190 dB re 1 $\mu Pa^2 m^2$ s (Hart Crowser et al. 2009; Houghton et al. 2010), which are below threshold associated with potential hearing injury in sea turtles (Finneran et al. 2017). Vibratory pile-driving noise can exceed levels associated with behavioral disturbances in sea turtles but only within short distances from the source (Denes et al. 2018; COP Appendix III-M; Epsilon 2022a). Given this low exposure probability, vibratory pile-driving noise impacts on sea turtles would be **negligible** at the individual and population levels.

Drilling activities used prior to pile-driving activities to remove soil and/or boulders from inside the piles in cases of pile refusal may produce SPL of 140 dB re µPa at 3,280 feet (Austin et al. 2018). This would exceed the continuous noise threshold of 120 dB re 1 µPa (Table 3.7-3) beyond 3,000 feet, but these events are expected to be short term, which limits the marine mammals potentially present during construction. While behavioral responses may occur from drilling, they are not expected to be long lasting or biologically significant to sea turtle populations.

There are several options for UXO removal that include stabilizing the UXO for safe relocation without detonation, low-order detonation designed to reduce the net explosive yield of a UXO compared to conventional “blow-in-place” techniques, as well as high-order detonation in which the full explosive weight is detonated in the place where the object is found. The appropriate method of removal for each project would depend on the condition of the UXO (i.e., how stable it is for potential relocation) and surrounding environmental conditions. With any detonation of explosives, there is the risk of mortality, non-auditory injury, auditory injury, and behavioral modification in the form of a TTS and brief disturbance of behavior to marine mammals. Potential impacts from in situ UXO detonation would result from both low- and high-order detonation methods, with less intense pressures and noise produced from the low-order detonations. However, though low-order detonation methods would generally be preferred by projects, they may not always fully eliminate the risk of high-order detonation, so potential impacts from in situ UXO disposal need to be assessed assuming high-order detonations would occur. Noise generated during detonation is dependent on the size and type of UXO, amount of charge used, location, water depth, soil conditions, and burial depth of the UXO.

Future offshore wind development may use helicopters to supplement crew transport during construction and operations. Helicopters transiting to the offshore SWDAs would fly at altitudes above those would cause behavioral responses from sea turtles, except when flying low to inspect WTGs or take-off and landing on the SOV. No published studies describe the impacts of aircraft overflights on sea turtles, although anecdotal reports indicate that sea turtles respond to aircraft by diving (BOEM 2017a). Bevan et al. (2018) observed no evident behavioral responses from sea turtles exposed to drones flown directly overhead at altitudes ranging from 59 to 102 feet. 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 2017a; NSF and USGS 2011; Samuel et al. 2005), these brief responses would 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 ensonified areas. The potential for auditory injuries (PTS) and temporary auditory impairment (TTS) is possible in proximity to active G&G acoustic surveys, but impacts are unlikely because turtles would likely avoid or leave areas of such exposure, and survey vessels would pass quickly in organized patterns (NSF and USGS 2011; Baker and Howsen 2021). G&G survey 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 more similar to common deep-water echosounders (Crocker and Fratantonio 2016; Crocker et al. 2019). Site characterization surveys for offshore wind facilities would create intermittent noise around sites of investigation over an assumed 8-year period. G&G surveys can extend for months, as would construction of structures associated with future offshore wind development. 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 sea turtle disturbance 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 2022d; Baker and Howsen 2021), and impacts on sea turtles from G&G survey activities would not result in stock or population-level impacts.

Cable laying would produce noise 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, and vessel and equipment used (Taormina et al. 2018). Data collected during cable installation for windfarms in Europe indicated source level for the activity ranged from 178 to 188.5 dB re 1 µPa-m (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 limited; however, available data suggest sea turtles may exhibit behavioral responses to anthropogenic noise at SPLs of 175 dB re 1 µPa or greater (Blackstock et al. 2018), which is likely to occur close to the activity given the estimated source levels (Bald et al. 2015; Nedwell and Howell 2004; Taormina et al. 2018). Therefore, it is unlikely that the sound exposure related to cable-laying activities would result in impacts on sea turtles.

While audible to sea turtles, noise associated with operational WTGs would not be expected to result in measurable impacts on individuals because the SPL generated by WTGs would be below the threshold for behavioral disturbances in sea turtles (Kraus et al. 2016a; Thomsen et al. 2015; Blackstock et al. 2018). Based on numerous measurements of wind farms in Europe, operational WTGs produce low-frequency (primarily less than 500 Hz) noise with broadband SPLs ranging from 92 to 137 dB re 1 µPa at distances of 65 to 656 feet from the source (Tougaard et al. 2020), and measurements at Block Island Wind Farm indicate average SPL 164 feet from the WTG were 119 dB re 1 µPa (HDR 2019b). Available data suggest sea turtles may exhibit behavioral responses to SPL at or above 175 dB re 1 µPa (Blackstock et al. 2018), which is louder than available recordings of operational WTG. Additionally, Tougaard et al. (2020) determined that sounds from operational WTG were comparable to or lower than commercial vessel sounds; even when multiple WTGs are operating concurrently within a region, a substantial increase in ambient noise levels would not occur. As such, no impacts on individual sea turtles would occur.

The frequency range for vessel noise (predominantly 10 to 1,000 Hz; MMS 2007) overlaps with sea turtles' most sensitive hearing range (less than 1,000 Hz with maximum sensitivity between 200 to 700 Hz; Bartol 1999) and would, therefore, be audible. However, Hazel et al. (2007) suggests that sea turtles' ability to detect approaching vessels is primarily vision-dependent, not acoustic. Sea turtles may respond to vessel approach and/or noise with a startle response (diving or swimming away) or 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. The potential impacts of noise from construction vessels would elicit brief responses to the passing vessel, which 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 22 and a maximum of 56 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 design and port locations. This increase in vessel traffic and associated noise impacts would be at its peak in 2026, when at least 16 offshore wind projects (not including the proposed Project) would be under simultaneous construction along the U.S. East Coast (i.e., a total of approximately 125 to 230 vessels in the geographic analysis area at any given time during peak construction). 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 have repeated localized, intermittent, short-term impacts on sea turtles, resulting in brief behavioral responses that would dissipate once the vessel or the turtle has left the area. These brief responses of individuals to passing vessels would be infrequent given the patchy distribution of sea turtles, and no stock or population-level impacts would occur.

Port utilization: Increases in global shipping traffic and expected increases in port activity along the U.S. East Coast from Maine to Virginia—including increased activity associated with future offshore wind projects—would require port modifications to receive the increase in shipping traffic and increased ship size. As described in Section G.2.7, Land Use and Coastal Infrastructure, numerous port and terminal expansions are planned or underway to support the offshore wind industry (including the projects that comprise Alternative A). Future channel deepening and subsequent maintenance 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 such risk would be highly localized to nearshore habitats. 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 would likely be a small percentage of available benthic habitat overall. Increased port utilization due to other offshore wind projects would lead to increases in vessel traffic, with peak vessel traffic occurring during construction activities, decreased activity during operations, and increased activity during decommissioning. In addition, any 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 offshore wind structures can lead to beneficial and adverse impacts on sea turtles through localized changes to hydrodynamic disturbance, prey aggregation and associated increase in foraging opportunities, incidental hooking from recreational fishing around foundations, entanglement in lost and discarded fishing gear, migration disturbances, and displacement. These impacts may arise from buoys, met towers, foundations, scour/cable protections, and transmission cable infrastructure during any stage of a project. Alternative A would include up to 2,955 foundations and 13,351 acres of new scour protection and hard protection atop cables. Projects may also install more buoys and met towers. Structures would be added intermittently beginning in 2022 and continuing through 2030 and beyond, and that they would remain until decommissioning of each facility is complete (assuming a 30-year project life).

Anthropogenic 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 3.8.1). 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 that is dependent on the pile diameter. For WTG and ESP foundations such as those included in the proposed Project, background conditions would return approximately 328 feet 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 existing conditions within a short distance.

The changes in fluid flow caused by the presence of an estimated 2,955 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 Section B.1 of Appendix B, Supplemental Information and Additional Figures and Tables. 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, which a mass of cold bottom water in the mid-Atlantic bight (the area offshore of the U.S. East Coast from Massachusetts to North Carolina) 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. 2018a). 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. The ultimate impacts on sea turtle prey species, and, therefore, sea turtles, are of changes to oceanographic and atmospheric conditions caused by offshore structures are not known at this time and 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 artificial 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 2 years 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 artificial 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 (Pezy et al. 2018; Raoux et al. 2017; Wang et al. 2019), indicating that offshore wind facilities can generate beneficial permanent impacts on local ecosystems, translating to increased foraging opportunities for some sea turtle species (Section 3.8.1.1). 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 Herczeg 1994; Gitschlag and Renauld 1989; Hastings et al. 1976; Rosman et al. 1987). As such, sea turtles would likely use habitat 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 is 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 artificial reef effect would result in beneficial impacts on sea turtles, some potential exists for increased exposure to high-intensity risk of interactions with fishing gear that may lead to entanglement, ingestion, injury, and death. The presence of structures may 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 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 2021, 186 sea turtles were documented as hooked or entangled with recreational fishing gear (Table 3.8-4). These data provided by the Sea Turtle Stranding and Salvage Network (NMFS 2021h) 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.

Table 3.8-4: Sea Turtle Probable Incidental Hooking and/or Entanglement with Fishing Gear from 2016 to 2021

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
Virginia	32	2	0	120	25	179
Delaware	1	1	0	1	0	3
New Jersey	1	0	2	0	1	4
New York	7	0	1	1	1	10
Massachusetts	0	0	20	0	0	20
Total	**41**	**3**	**23**	**122**	**27**	**216**

Source: NMFS 2021h

The artificial reef effect may attract recreational fishing effort from inshore areas, as well as sea turtles for foraging opportunities, resulting in a small increase in interactions between sea turtles and fisheries at WTG locations if both fishing and turtles are concentrated around the same foundations. Due to the large number of foundations in each wind development area within the RI/MA Lease Areas, it is likely that recreational and for-hire fisheries would avoid overcrowding structures by dispersing effort across many WTG foundations. However, the risk of entanglement and hooking or ingestion of marine debris could slightly increase as both fishers and turtles may be attracted to the same areas.

Some level of sea turtle displacement out of the lease areas into areas with a higher potential for interactions with ships or fishing gear during the construction stages of future offshore wind development may occur. Given the use of structures in the Gulf of Mexico by sea turtles, as described above, no long-term displacement would occur. After construction, some commercial and recreational fishing vessels may be displaced outside of the WTG grid, and Alternative A would impact all fisheries and all gear types (Section 3.9, Commercial Fisheries and For-Hire Recreational Fishing). Bottom tending mobile gear is more likely to be displaced than fixed gear. Future offshore wind projects would be more likely to displace larger fishing vessels with small mesh bottom-trawl gear and mid-water trawl gear compared to smaller fishing vessels with similar gear types that may be easier to maneuver. Shifts in fishing effort to areas adjacent to offshore wind projects (as opposed to within the projects) would not increase the risk of sea turtle interaction with fishing gear beyond current levels due to the patchy distribution of sea turtles. In addition to displacement of fishing effort Alternative A could prompt a shift in gear types from fixed to mobile, or from mobile to fixed gear. The impact of such gear shifts (if they occur) on sea turtles is uncertain. To the degree that gear type shifts increase the number of vertical fishing lines in the water column (and absent a commensurate shift from fixed-gear types to mobile gear), that shift would increase the risk of sea turtle interactions with fishing gear.

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 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 speeds may exceed 10 knots in such waters, and those vessels traveling at greater than 10 knots would pose the greatest threat to sea turtles, particularly during nighttime or periods of poor visibility and elevated sea state (Hazel et al. 2007). As described for the noise IPF above, at the peak of proposed Project construction from, up to

896 vessels associated with offshore wind development along the U.S. East Coast may be operating in the geographic analysis area. This vessel traffic increase would be small compared to overall vessel traffic volumes within the geographic analysis area for sea turtles. Further, collision risk would only be expected when proposed Project vessels are transiting to and from the lease areas. Once in the lease areas, vessels would typically be stationary with no collision risk, except during transits between locations within each lease area. This increased collision risk from transiting proposed Project vessels could cause injury or mortality for individual sea turtles but would not have stock or population-level impacts due to their patchy distribution within the geographic analysis area. Further, the required mitigation and monitoring measures to minimize potential vessel impacts on sea turtles that would be implemented during construction, operations, and decommissioning of future offshore wind facilities would further reduce the risk of injury and mortality (Appendix H, Mitigation and Monitoring).

Conclusions

Impacts of Alternative A. Under Alternative A, sea turtles would continue to follow current regional trends and respond to current and future environmental and societal activities. While the proposed Project would not be built as proposed, ongoing activities would 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. Impacts of ongoing activities, especially vessel traffic, commercial and recreational fishing gear interaction, and climate change would be **moderate**.

Cumulative Impacts of Alternative A. In addition to ongoing activities, planned activities other than offshore wind development include increasing vessel traffic, commercial and recreational fishing, new submarine cables and pipelines, channel deepening activities, and the installation of new towers, buoys, and piers (Appendix G). The impacts of planned activities other than offshore wind would be **minor**. The combination of ongoing activities and planned activities other than offshore wind development to result in **moderate** impacts on sea turtles, driven primarily by increasing vessel traffic and commercial and recreational fishing gear interactions.

Considering all the IPFs together, the cumulative impacts of Alternative A with other ongoing and planned activities in the geographic analysis area would result in **moderate** impacts, predominantly due to impact pile-driving noise and increased vessel traffic, as well as **moderate** beneficial impacts throughout the life of the projects due to the presence of structures and associated artificial reef impacts. 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 cable emplacement and EMF, but impacts on sea turtles resulting from these IPFs would be localized and temporary and would not be biologically significant.

3.8.2.2 Relevant Design Parameters and Potential Variances in Impacts

The following proposed Project design parameters (Appendix C, Project Design Envelope and Maximum-Case Scenario) would influence the magnitude of impacts on sea turtles:

- The WTG foundation type used: The potential acoustic impacts on sea turtles differ among the WTG foundation types that the proposed Project would use either 12-meter monopile foundations or 4-meter jacket foundations during Phase 1, and either 13-meter monopile foundations or 4-meter jacket foundations during Phase 2 of the proposed Project.
- The number of WTGs and ESPs installed: The scale of potential acoustic impacts on sea turtles increases with the number of WTGs and ESPs installed.

Aspects of the proposed Project design include the OECC route, the WTG design selected (e.g., monopile, jacket-type), the exact placement and number of WTGs and ESPs, the final inter-array cable layout, and the construction schedule, which would be determined based on-site assessment data, engineering requirements, and other factors. Although some variation is expected in the design parameters, the impact assessment in this section analyzes the maximum-case scenario.

3.8.2.3 Impacts of Alternative B – Proposed Action on Sea Turtles

This section identifies potential impacts of Alternative B on sea turtles. Except where otherwise stated, the impacts of Phase 1 decommissioning would be similar to those for Phase 1 construction for all of the IPFs described below.

Impacts of Phase 1

Construction of Phase 1 would affect sea turtles through the following primary IPFs during construction, operations, and decommissioning.

Accidental releases: Accidental releases of hazardous materials and trash/debris during Phase 1 would be similar to those described for Alternative A and would not increase the risks to sea turtles beyond that described for Alternative A. The risk of any type of accidental release would be increased primarily during construction or decommissioning but may also occur during operations of the proposed Project. Alternative B would comply with 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 proposed Project personnel, reducing the likelihood of an accidental release (Appendix H). In the unlikely event of an accidental spill, hydrocarbons could impact sea turtles within 30 to 50 miles of the spill if no protective measures are put in place (COP Volume III, Appendix I-F; Epsilon 2022a). The potential impacts of exposure would be sublethal based on the low concentration of hydrocarbons during a potential sea turtle exposure event. Oil spill modeling for Alternative B is provided in the COP (Volume III, Appendix 1-F, Attachment 11; Epsilon 2022a). Additional oil spill modeling details contained in the NMFS BA and associated BO for the proposed Project (BOEM 2022d; NMFS 2022b) are illustrative of the potential oil spill impacts of Phase 1. Additionally, adherence to the applicant's OSRP would decrease potential impacts from spills. Therefore, due to the unlikelihood of an oil spill, the sublethal level of impact, and the implementation of an OSRP, potential temporary impacts, if any, on sea turtles from accidental oil (or other chemical) spills would be **negligible**, due to the rare, brief, and highly localized nature of accidental releases.

While the significance level of impacts would remain the same, BOEM is evaluating the following mitigation and monitoring measure to address impacts on sea turtles, as described in detail in Table H-2 of Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

- Provide proposed Project personnel with informational training on proper storage, handling, and disposal practices to reduce the likelihood of accidental discharges of hazardous materials and trash/debris.

Anchoring and gear utilization: Monitoring survey methods for Alternative B may include otter trawl, ventless trap sampling, lobster tagging, Neuson net sampling, video and still imaging, sediment profile and plan view imaging, and grab sampling. As described in Section 3.8.2.1, survey gear could affect sea turtles through entanglement or entrapment. Trawl nets pose a negligible threat to sea turtles, and the slow speed of mobile gear and short tow times (less than 30 minutes) further reduce the potential for entanglements or other interactions. Fish traps and the anchoring lines and buoys used to secure them may pose an entanglement risk to sea turtles, although these risks would be mitigated because trap surveys would be required to utilize mitigation measures to further reduce entanglement risk (e.g., ropeless gear, biodegradable components). Therefore, impacts on sea turtles from traps are expected to be **negligible** based on the limited number of associated buoy lines, the short duration of sampling events, and the low probability for gear entanglement. Given the short-term, low-intensity, and localized nature of the impacts of gear utilization for Alternative B, as well as the proposed mitigation and minimization measures, impacts on sea turtles would be **negligible**.

Cable emplacement and maintenance: Sea turtles in the SWDA would likely be foraging for prey items including amphipods and other crustaceans, crabs, gastropods, and bivalves (BOEM 2014c). Phase 1's incremental contribution of up to 442 acres of seafloor disturbed by cable installation and up to 67 acres affected by dredging prior to cable installation would result in turbidity impacts that could temporarily affect some sea turtle prey species, including benthic mollusks, crustaceans, sponges, sea pens, and crabs. Impacts from the emplacement of export and inter-array cabling from other projects would not overlap spatially with Phase 1 (Appendix E), and no additional impacts would occur. Suspended sediment concentrations during activities other than dredging would be within the range of natural variability in the SWDA and OECC. Any dredging necessary prior to cable installation could also generate additional water quality impacts. Construction would affect a small percentage of the available foraging habitat in the geographic analysis area. Benthic recolonization and recovery to pre-construction species assemblages are expected within 2 to 4 years (Van Dalfsen and Essink 2001) but may be as rapid as 100 days (Dernie et al. 2003) due to the similarity of nearby habitats and related species. Because impacts on foraging habitats are mostly temporary and localized, and individual sea turtles, if present, would successfully forage in nearby areas not affected by increased sedimentation, only **negligible** impacts, if any, on individual sea turtles would occur (NOAA 2021b).

Although construction would have the greatest impact on sea turtles, the maintenance of these cables would also result in potential impacts, specifically when cable repairs are required or cable protection is added. Cable protection would be needed where cable burial desired depth is not feasible. Methods of cable protection would include rocks, gabion rock bags, or concrete mattresses. The applicant estimates approximately 6 percent of the offshore export cables and approximately 2 percent of inter-array and inter-link cables would require cable protection due to insufficient burial depth, totaling approximately 266 acres of hard protection. Recovery rates of these disturbed surfaces would depend on the sea turtle prey species present and their recovery capabilities and would result in **negligible** impacts on individual sea turtles. The impacts of cable removal during Phase 1 decommissioning would be similar to construction: **negligible**.

Climate change: The surveying, construction, and decommissioning activities associated with Phase 1 would produce GHG emissions that can be assumed to contribute to climate change; however, these contributions would be minute (i.e., 6,990 metric tons) compared with aggregate global emissions. The impact of GHG emissions on sea turtles from the proposed Project would not be detectable and would, therefore be **negligible**.

Operations of Phase 1 would marginally reduce or displace emissions from conventional power generation, thereby contributing to slowing or arresting global warming and associated climate change and having a long-term and **negligible** beneficial impact on sea turtles.

EMF: Both the OECC and inter-array systems are AC cables, and the applicant would bury all cables at a depth of 5 to 8 feet. Modeled magnetic field levels for Phase 1 indicate that the proposed Project AC would emit a maximum field intensity of 84.3 milligaus [mG] directly above the center line, which decreases to 5.6 mG at 20 feet from the centerline (Gradient 2020). Comparison of these results with sensitivity levels for sea turtles suggests that sea turtles are likely magnetosensitive and orient to Earth's magnetic field for navigation, but they are unlikely to detect magnetic fields below 50 mG (Normandeau 2011). Although desktop studies suggest that sea turtles are capable of sensing magnetic fields from submarine cables, there is little evidence that these small EMFs along a cable corridor would affect turtle navigation or orientation (Normandeau 2011; Papi et al. 2000). Additionally, no nesting beaches, critical habitat, or other biologically important habitats have been identified in the SWDA or OECC that could result in harm to sea turtles should any minor behavioral response occur and animals leave the immediate area. Therefore, the potential long-term impacts on sea turtles exposed to magnetic fields from cables installed under Phase 1 would not be measurable. While EMF associated with the proposed Project's submerged cables would be detectable by sea turtles, **negligible** impacts would occur 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. These **negligible** impacts would be removed following proposed Project decommissioning.

Lighting: Phase 1 would contribute lighting from up to 62 WTGs and 1 or 2 ESPs during Phase 1, all of which would be lit with navigational and FAA hazard lighting. Vessel lights during construction and decommissioning (particularly deck working lights) would be substantial, based on the number of vessels involved in the operations. The BA (BOEM 2022d) and associated BO (NMFS 2022b) analyzes the potential impacts of the proposed lighting on sea turtles. Based on the intermittent nature of the proposed lighting, potential long-term impacts of lighting on sea turtles, if any, would be **negligible**.

The proposed Project would include ADLS to reduce operations nighttime lighting impacts. ADLS would only activate the red flashing required FAA aviation obstruction lights on WTGs and ESPs when aircraft enter a predefined airspace and turn off when the aircraft are no longer in proximity to the SWDA (COP Appendix III-K; Epsilon 2022a). ALDS activation for Phase 1 would occur for approximately 9 minutes per year (less than 0.1 percent of annual nighttime hours) (COP Appendix III-K; Epsilon 2022a). Proposed Project-related vessel lighting during operations and during vessel transits would include deck lighting, but exposure would be of shorter duration than during construction. Based on the intermittent nature of the proposed lighting and the lack of evidence that offshore platform illumination leads to impacts on sea turtles, potential long-term impacts of lighting on sea turtles, if any, would be **negligible**. Impacts resulting from vessel lighting during the course of proposed Project decommissioning would be similar to those described under operations: **negligible**.

Noise: Studies indicate that hearing in sea turtles is generally confined to lower frequencies, below 2,000 Hz, with the range of highest sensitivity between 100 and 700 Hz (Dow Piniak et al. 2012). Table 3.8-5 summarizes current data for species-specific hearing range frequencies. These data were obtained by recording a sea turtle's auditory evoked potential (AEP). AEP is an electrical response within the sea turtle central nervous system produced when a sound is detectable by the ear (Yost 2007; Au and Hastings 2008). By exposing a sea turtle to various sound intensities and frequencies and recording whether an AEP response occurs, researchers are able to estimate the hearing capabilities of the individuals tested.

Table 3.8-5: Sea Turtle Hearing Ranges[a]

Common Name	Scientific Name	Hearing Range (Hz)	Most Sensitive Hearing Range (Hz)	Reference
Loggerhead sea turtle	*Caretta caretta*	100–1,130 50–80[b]	200–400 (at 110 dB re 1 µPa) 100 (at 98 dB re 1 µPa)	Martin et al. 2012
Kemp's ridley sea turtle	*Lepidochelys kempii*	100–500	100–200	Bartol and Ketten 2006
Green sea turtle	*Chelonia mydas*	50–1,600	600–700	Piniak et al. 2016
Leatherback sea turtle	*Dermochelys coriacea*	50–1,200	10 –400	Dow Piniak et al. 2012

AEP = auditory evoked potential; dB re 1 µPa = decibels referenced to 1 micropascal; Hz = hertz

[a] Hearing ranges based on AEP unless otherwise noted.

[b] This is based on behavioral testing.

COP Appendix III-M (Epsilon 2022a) summarizes acoustic exposure modeling for sea turtles during pile driving of the two foundation types (monopile and jacket foundations) and three levels of attenuation (0 dB, 10 dB, and 12 dB), using the most recent available density data (Table 3.8-2) and sea turtle behavioral data (COP Appendix III-M; Epsilon 2022a). The 0 dB level was modeled as a reference point to evaluate the effectiveness of the proposed sound reduction technology (e.g., hydro-sound damper, bubble curtains, or similar). A description of the 95 percentile exposure-based range ($ER_{95\%}$) and the incorporation of the mitigation is provided in Section 3.7, Marine Mammals. Similar to marine mammals, the scenarios with the highest hammer energy are presented in this assessment as they represent the maximum potential risk of impact on sea turtles. Tables 3.8-6 and 3.8-7 summarize the threshold distances for all sea turtle species modeled in the COP (Appendix III-M; Epsilon 2022a).

Sightings and density data indicate that sea turtles are most susceptible to impacts from pile driving during the summer and fall, when expected abundances in the SWDA are relatively moderate to high (August through November) (Kraus et al. 2016a; COP Appendix III-M; Epsilon 2022a; O'Brien et al. 2021a, 2021b). Based on the results of the acoustic and exposure modeling (COP Appendix III-M; Epsilon 2022a), there is a potential risk of PTS and behavioral disturbance to sea turtles from pile driving. The maximum $ER_{95\%}$ to the SEL_{24h} PTS threshold from unattenuated installation ranges from 1,443 to 4,987 feet (440 to 1,520 meters) for the jacket foundations and 2,067 to 7,349 feet (630 to 2,240 meters) for the monopile foundations (Tables 3.8-6 and 3.8-7). When 10 dB noise attenuation is applied, these ranges drop to 0 to 131 feet (0 to 40 meters) and 33 to 556 feet (10 to 170 meters), respectively. Although the applicant would aim for 12 dB or greater attenuation, it is not guaranteed this would be achieved for every pile installation so 10 dB was considered the highest level of noise attenuation for the assessment in this EIS. Because some of this space within the ensonified area would be occupied by the physical presence of noise mitigation system itself, and additional measures such as trained observers monitoring the zone immediately around construction vessels and prohibiting pile driving when a sea turtle was present within a 500-foot clearance zone surrounding the vessel, it is unlikely any sea turtle would be present within these ranges for sufficient duration to experience PTS impacts.

Table 3.8-6: Exposure-Based Ranges ($ER_{95\%}$) in Meters to Injury and Behavioral Thresholds, Jacket Foundation Piles with 0, 10, and 12 dB Noise Attenuation[a]

	Distance to PTS Threshold (Lpk)			**Distance to PTS Threshold (SEL_{24h})**			**Distance to Behavioral Threshold (SPL)**		
Species	**0 dB**	**10 dB**	**12 dB**	**0 dB**	**10 dB**	**12 dB**	**0 dB**	**10 dB**	**12 dB**
Kemp's ridley sea turtle *(Lepidochelys kempii)*	0	0	0	680	40	0	2,340	470	330
Leatherback sea turtle (*Dermochelys coriacea*)	0	0	0	710	30	0	2,170	450	330
Loggerhead sea turtle (*Caretta caretta*)	0	0	0	440	0	0	2,150	440	270
Green sea turtle (*Chelonia mydas*)	0	0	0	1,520	30	20	2,760	580	380

Source: COP Volume III, Appendix III-M, Table 43; Epsilon 2022a

μPa^2 s = micropascal squared second; dB = decibel; dB re 1 µPa = decibels referenced to 1 micropascal; kJ = kilojoule; Lpk = peak sound pressure (dB re 1 µPa); PTS = permanent threshold shift; SEL_{24h} = sound exposure level over 24 hours (dB re 1 μPa^2 s); SPL = root-mean-square sound pressure level (dB re 1 µPa)

[a] Assumes four, 4-meter piles installed per day using 3,500 kJ hammer energy.

Table 3.8-7: Exposure-Based Ranges ($ER_{95\%}$) in Meters to Injury and Behavioral Thresholds, 12-Meter Monopile Foundations with 0, 10, and 12 dB Noise Attenuation

Species	Distance to PTS Threshold (Lpk)			Distance to PTS Threshold (SEL_{24h})			Distance to Behavioral Threshold (SPL)		
	0 dB	10 dB	12 dB	0 dB	10 dB	12 dB	0 dB	10 dB	12 dB
Kemp's ridley sea turtle *(Lepidochelys kempii)*	20	20	20	1,120	20	20	3,570	1,770	1,310
Leatherback sea turtle (*Dermochelys coriacea*)	20	20	20	1,270	170	20	3,240	1,350	1,120
Loggerhead sea turtle (*Caretta caretta*)	10	10	10	630	10	10	3,050	1,200	850
Green sea turtle (*Chelonia mydas*)	10	10	10	2,240	150	30	3,650	1,830	1,490

Source: COP Volume III, Appendix III-M, Table 40; Epsilon 2022a

μPa^2 s = micropascal squared second; dB = decibel; dB re 1 µPa = decibels referenced to 1 micropascal; kJ = kilojoule; Lpk = peak sound pressure (dB re 1 µPa); PTS = permanent threshold shift; SEL_{24h} = sound exposure level over 24 hours (dB re 1 μPa^2 s); SPL = root-mean-square sound pressure level (dB re 1 µPa)
[a] Assumes two, 12-meter piles installed per day using 6,000 kJ hammer energy.

Results of the modeling indicate a greater relative risk of behavioral disturbances. Behavioral responses to pile-driving activities could range from a startle with immediate resumption of normal behaviors to complete avoidance of or displacement from the area and could also include changes in diving patterns or changes in foraging behavior (NMFS 2020a). With 10 dB noise attenuation, the behavioral threshold for sea turtles may be met up to 1,444 to 1,903 feet (440 to 580 meters) from the jacket piles and 3,937 to 3,004 feet (1,200 to 1,830 meters) from the monopiles (Tables 3.8-6 and 3.8-7). Sea turtles foraging, migrating, or resting within these ranges from the piles being driven are expected to temporarily stop these behaviors and/or make evasive movements (changes in diving or swimming patterns) until they are outside the area where noise is elevated above an SPL of 175 dB re 1 µPa (NMFS 2020a; COP Appendix III-M; Epsilon 2022a). Given that the piles would be installed at a fixed location within an open ocean environment with no impediments to movement, sea turtles are expected to be able to avoid the ensonified area (NMFS 2020a). Depending on the species and how close the individual is to the pile being driven, this could involve swimming up to 1.1 miles (1.8 kilometers). The turtle may experience physiological stress during this avoidance behavior, but this stressed state is expected to dissipate once the sea turtle is outside the ensonified area. Assuming the model predictions are a comprehensive representation of the proposed Project and considering that sea turtles would likely not be present within the SEL-based PTS threshold ranges provided in Tables 3.8-6 and 3.8-7 for a sufficient time to experience PTS, **minor** impacts on individual sea turtles would occur. There have been no documented sea turtle mortalities associated with pile driving, and sea turtle anatomy may make them resistant to percussive shock waves due to their skeletal structure and construction of their skulls, which helps to reflect or mitigate the effect of rapid increases in underwater pressure (Madin 2009). Based on the relatively low densities of sea turtles in the SWDA, 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 occur. The most likely impact would be from temporary behavioral disturbance associated with impact pile-driving activities. Implementation of 10 dB noise attenuation and other mitigation and monitoring measures such as soft start and shut downs (Appendix H), though geared primarily for marine mammals, would minimize the risk of biologically significant behavioral impacts as it would reduce the overall amount of time noise exceeding the behavioral threshold for sea turtles is present within the geographic analysis area. Impacts from behavioral disturbances on sea turtles during impact pile driving would, therefore, be **moderate**.

As discussed for marine mammals (Section 3.7), vibratory setting and drilling may be used on a portion of the piles to reduce the risk of pile run. While vibratory pile setting and drilling were not modeled for sea turtles, the COP (Appendix III-M; Epsilon 2022a) provides a qualitative assessment of vibratory pile driving using published data, which indicated a very low risk of injury or potential disturbance for any sea turtle species. Vibratory setting and drilling would produce lower sound levels relative to impact pile driving and would occur over a fewer number of piles so the duration of these activities would be shorter (COP Appendix III-M; Epsilon 2022a; JASCO 2022). Impacts from vibratory pile setting and drilling may, therefore, result in **minor** impacts on sea turtle species in the geographic analysis area.

Potential UXO detonations would also present a risk of impact on sea turtles, as described in Section 3.7 for marine mammals. Preliminary survey data for the geographic analysis area indicates there is a risk of UXOs that cannot be avoided or removed through non-explosive methods. The analysis in the Letter of Authorization application (JASCO 2022) estimated up to 10 UXO may be detonated during construction. Underwater detonations of UXO present the risk of non-auditory injury for sea turtles such as lung or gastrointestinal injuries; PTS; and behavioral disturbances represented by TTS (U.S. Navy 2017). A quantitative analysis of ranges to non-auditory injury, PTS, and TTS ranges was not included for sea turtles (JASCO 2022); however, based on the thresholds from Finneran et al. (2017) and the result of the analysis for marine mammals (Section 3.7), non-auditory injury and mortality are not expected to occur, and the most likely impacts on sea turtles would result from PTS and TTS. Mitigation such as 10 dB noise attenuation and pre-clearance surveys would further reduce the risk of sea turtles being exposed to noise above PTS- and TTS-onset thresholds. Impacts from potential UXO detonations would, therefore, be expected to result in **moderate** impacts on sea turtles.

Helicopters transiting to the SWDA would fly too high for their noise to cause behavioral responses from sea turtles, except when flying low to inspect WTGs or when taking off and landing on the SOV. While helicopter traffic may cause some short-term behavioral reactions in sea turtles (BOEM 2017a; NSF and USGS 2011; Samuel et al. 2005), these brief responses would dissipate once the aircraft has left the area. These impacts would be temporary, short term, and **negligible**, resulting in minimal energy expenditure.

Noise from G&G surveys associated with the pre-construction site investigation used to aide installation of proposed Project cables and foundations may affect sea turtles. The G&G 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. Boomers and sparkers have an operating frequency range of 200 Hz to 16 kilohertz (kHz) and could be audible to sea turtles; however, these sources have very short pulse lengths (120, 150, or 180 microseconds) and a very low source level. No injurious impacts are expected for sea turtles from any G&G survey equipment (Baker and Howsen 2021). G&G equipment operating at the highest power setting could cause behavioral disturbances up to 295 feet from impulsive sources and up to 6.6 feet from non-impulsive sources (Baker and Howsen 2021). As such, BOEM believes that injury is unlikely due to the narrow radius of effect and the brief duration of the acoustic impacts. Because the potential for injury is small and potential behavioral responses would be brief, temporary, and result in no long-lasting impacts, **negligible** impacts on sea turtles from G&G survey noise would occur.

The fall pipe technique used for placement of cable protection may include the use of a ROV. Data for underwater sound levels from ROVs are limited and highly variable; however, noise produced by ROVs or the equipment operating from ROVs are not expected to result in impacts (Baker and Howsen 2021). The potential impacts from ROV operations would likely be comparable to other DP vessel traffic present throughout proposed Project construction. The frequency range for DP vessel noise overlaps with sea turtles' known hearing range and would, therefore, be audible; however, Hazel et al. (2007) suggest that sea turtles' ability to detect approaching small boats 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). The potential temporary impacts of noise from construction vessels on disturbance of sea turtles would be localized, short term, and **negligible**.

As outlined above, no serious injury or mortality is expected to occur as a result of impact pile-driving activities. The applicant has committed to using noise-reduction technologies during all pile-driving activities to ensure a minimum attenuation of 6 dB would reduce the area impacted by noise during construction. The specific technologies have not yet been selected; potential options include a noise mitigation system, hydro-sound damper, noise abatement system, a bubble curtain, or similar (COP Appendix III-M; Epsilon 2022a). The applicant would use protected species observers (PSO) during pile-driving and G&G survey activities to reduce the potential noise impacts by establishing and maintaining exclusion zones to minimize sea turtle exposure to injurious levels of noise. The detectability of sea turtles is dependent upon metrological conditions, PSO training, PSO fatigue, and animal behavior. PSO training and shift requirements, as detailed in Appendix H, would increase the ability of PSOs to detect listed species. The applicant would also submit an alternative monitoring plan to ensure the ability to maintain exclusions zones during adverse monitoring conditions.

While the significance level of impacts would remain the same, BOEM is evaluating the following mitigation and monitoring measures to address impacts on sea turtles, as described in detail in Table H-2 of Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

- Monitor pile-driving noise to comply with required noise reductions identified through consultations with NMFS (Appendix A, Required Environmental Permits and Consultations; Appendix H);
- Refine exclusion zones based on field measurements;
- Perform daily surveys prior to starting any pile-driving activities to ensure that marine mammals and sea turtles are not present in the area at the start of pile driving;
- Use pile-driving time of day restrictions to ensure that all clearance zones are maintained; and
- Report—daily and weekly—sea turtles observed, if any, during pile-driving operations.

The combined impacts on sea turtles due to various anthropogenic noise sources on sea turtles from construction of Phase 1 are expected to range from **negligible** to **moderate**. The **moderate** and temporary impacts that would result from impact pile driving would cease once pile driving stops, at which point sea turtle behavior would return to normal. Although permanent hearing impairment could occur, there is evidence that sea turtles rely upon other senses including magnetic orientation (Avens and Lohmann 2003; Light et al. 1993; Putman et al. 2015) and vision (Avens and Lohmann 2003; Narazaki et al. 2013) Affected individuals may not have to adjust their life history strategies in response to auditory injury, but the consequences of hearing impairment in sea turtles are difficult to study and are not well understood. However, as discussed above and in the BA for the proposed Project (BOEM 2022d), PTS is not expected to occur as a result of Phase 1.

The only noise present during operations would be from G&G surveys, vessel noise, and WTG operations. Noise from G&G surveys during Phase 1 operations would be the same as described for construction. Sea turtles would likely be able to hear the continuous underwater noise of operational WTGs throughout the life of the proposed Project. However, based on the results in Kraus et al. (2016a) and Tougaard et al. (2020), the received SPLs generated by the WTGs are expected to be at or below ambient levels at relatively short distances from the foundations, and noise from vessel traffic is expected generally to exceed noise from operational WTGs. The proposed Project BA and associated BO provide detailed discussions on the continuous underwater noise produced from the operation of wind turbines (BOEM 2022d; NMFS 2022b). Vessel traffic would continue to be present throughout the operational life of the proposed Project. The types of vessels present during operations would consist primarily of smaller supply or crew vessels, and the larger transport vessels used during construction would not be used, which would lower the risk of severe injury occurring. However, because vessel activities associated with the proposed Project would be present through the life of the proposed Project, the potential impacts on sea turtles are expected to be the same as what was described for construction. Impacts from noise during Phase 1 operations would, therefore, be **negligible**.

Decommissioning impacts would include noise emitted from underwater acetylene cutting torches, mechanical cutting, high-pressure water jets, and vacuum pumps. SPLs are not available for these types of equipment but are not expected to be higher than construction vessel noise (i.e., generally between 177 and 200 dB re 1 μPa m [Erbe et al. 2019]). In addition, the applicant would conduct G&G and ROV surveys for site clearance activities, which would have similar impacts as those described for similar activities during construction and operations. Overall, potential impacts from noise on sea turtles during decommissioning are expected to be **negligible**.

Port utilization: A number of existing ports would be used by proposed Project vessels throughout the duration of Phase 1 construction and operations activities o. However, Phase 1 of the proposed Project does not include implementing any port upgrades or modifications (COP Volume I, Section 3.2.2.5; Epsilon 2022a). As no port expansion activities are considered, Phase 1 would not impact sea turtle populations. Impacts on sea turtles would, therefore, be **negligible**.

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 3.8.2.1. Phase 1 would result in a conversion of soft-bottom habitat to hard-bottom due to scour protection. Based on the assumptions in Appendix E, future offshore wind development would result in up to approximately 18,468 acres of structures and associated scour protection, as well as new hard protection for cables. Of this area, only 108 acres would result from Phase 1, and the remainder would result from other offshore wind projects in the geographic analysis area. Phase 1 would contribute up to 63 of the estimated 2,955 WTGs and ESPs in the RI/MA Lease Areas. The structures and scour/cable protection, and the potential consequential impacts, would remain at least until decommissioning of each facility is complete (assuming a 30-year project life). As described above, structures associated with the proposed Project would provide some level of artificial reef effect and may result in long-term and **minor** beneficial impacts on sea turtle foraging and sheltering; however, long-term and **minor** impacts could occur as a result of increased interaction with active or ghost fishing gear (Shigenaka et al. 2010; Duncan et al. 2017) and/or interruptions of important life history behaviors.

The artificial reef effect and associated increase in fish biomass as described for Alternative A could increase recreational fishing effort in the SWDA. Fishing in and around turbine foundations may increase marine debris from fouled fishing gear in the area. Additionally, biological surveys for pre- and post-construction monitoring of proposed Project-related impacts on sea turtles could include the following methodologies:

- Benthic grab sampling and analysis;
- Sediment profile imaging acquisition and processing;
- High-resolution multibeam depth sounding and video survey;
- Trawl survey for finfish and squid;
- Ventless trap survey;
- Plankton survey; and

- Optical survey (drop-camera) of benthic invertebrates and habitat.

The use of nets, towed line, and buoys for proposed Project-related monitoring would contribute to the possibility of entanglement.

Current threats to sea turtles include fishing gear and ingestion of marine debris. Entanglement and ingestion of marine debris is not considered a new IPF, but rather a change in the distribution of this factor if inshore fishing effort is moved offshore. A slight increase in concentrations of fishing activity and sea turtles may occur around WTG foundations; therefore, the impacts of fishing on sea turtles due to potential artificial reef impacts may occur in a slightly different location near the WTG foundations. However, any detectable increase in interactions with fishing gear is not expected; therefore, impacts would be **negligible**. Although impacts are expected to be **negligible**, impacts around the WTG foundations resulting from the redistribution of fishing effort may be measurable. These **negligible** impacts would be removed following proposed Project decommissioning.

While the significance level of impacts would remain the same, BOEM is evaluating the following mitigation and monitoring measure to address impacts on sea turtles, as described in detail in Table H-2 of Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

- Conduct annual remotely operated underwater vehicle surveys, reporting, and monofilament and other fishing gear cleanup around WTG foundations.

Though 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 but be greatly reduced over the lifetime of the proposed Project. Overall, the presence of structures associated with Phase 1 would result in **negligible** to **minor** impacts on sea turtles, as well as potential **minor** beneficial impacts resulting from increased foraging and sheltering opportunities.

The removal of the WTG and ESP foundations during decommissioning would remove the beneficial impacts resulting from the increased foraging and sheltering opportunities, which may result in **minor** impacts on sea turtles due to the loss of this beneficial habitat. However, if the foundations are removed, it is expected the SWDA would return to near existing conditions, and there would not be any long-term loss of foraging opportunities in the SWDA.

Traffic: Propeller and collision injuries from boats and ships are common for sea turtles. Sea turtles are likely to be most susceptible to vessel collision in coastal waters, where they forage, when vessels transit from ports. Vessel speed may exceed 10 knots during such transits, and vessels traveling at greater than 10 knots pose the greatest threat to sea turtles (Hazel et al. 2007). Discussions of sea turtle vessel strikes in the Vineyard Wind 1 BO are applicable to Phase 1 (NMFS 2020a). The risk of vessel strike would be increased primarily during construction or decommissioning when the largest number of vessels are operating but may also occur during operations of the proposed Project. Construction vessels would range in size from 66 to 98 feet to 394 to 732 feet, with operational speeds from 10 to 25 knots. During the most active construction period, the applicant estimates an average of 22 proposed Project-related vessels operating within the SWDA or along the OECC at any given time and up to approximately 56 proposed Project-related vessels operating concurrently within the SWDA during high-traffic periods (COP Volume I, Section 3.3.1.12.1; Epsilon 2022a). In an extreme case, all 22 of these vessels could need to travel to or from New Bedford Harbor or a secondary port in the same day; however, the applicant estimates that activities during Phase 1's most active period would typically generate a maximum of 15 vessel trips per day to or from ports. The maximum number of vessels involved in Phase 1 at any one time is highly dependent on the proposed Project's final schedule, the final design of the proposed Project's components, and the logistics solution used to achieve compliance with the Jones Act (COP Appendix III-I; Epsilon 2022a). Vessel traffic associated with Phase 1 poses a high frequency, high exposure collision risk to sea turtles in coastal waters, particularly during operations at night and/or during periods of poor visibility and high sea states. However, Phase 1 would result in only a small incremental increase in vessel traffic, with a peak during proposed Project construction. Based upon the analysis provided in the Vineyard Wind 1 BO (NMFS 2020a), there may be up to 54,305 annual vessel trips through the SWDA and OECC. Using this baseline vessel traffic in the area (NMFS 2020a), Phase 1 construction would result in a 4.7 percent annual increases in vessel traffic during construction.

The applicant anticipates that WTG and ESP components, as well as offshore export cables would be shipped from Canadian and European ports, either directly to the SWDA or through a U.S. port. A total of approximately 936 vessel round trips, with approximately 39 round trips per month, are anticipated over the 2-year construction schedule (COP Appendix III-I; Epsilon 2022a). These estimates are based upon the installation of up to 63 foundations (including up to 2 ESPs, with the remainder for WTGs) during Phase 1 and represent the maximum-case scenario. It is expected that these vessels would follow the major navigation routes and would be making similar trips to U.S. ports in the absence of Phase 1 (Michael Clayton, Pers. Comm., July 23, 2020).

While the significance level of impacts would remain the same, BOEM is evaluating the following mitigation and monitoring measures to address impacts on sea turtles, as described in detail in Table H-2 of Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval. These measures are designed to reduce the amount and extent of ESA-listed species take related to pile-driving noise and vessel strike:

- Require vessel strike avoidance procedures and protected species reporting to ensure vigilance by vessel crews during transit;
- Require vessel observers to monitor a vessel strike avoidance zone around proposed Project vessels; and
- Use AIS to monitor the number of proposed Project vessels, traffic patterns, and proposed Project vessel compliance with required speed restrictions.

With the implementation of the measures listed above, vessel strikes as a result of Phase 1 would be low, and impacts on sea turtle individuals through this IPF would likely be **moderate**, and no population-level impacts would occur.

Impacts of Phase 2

Impact levels for Phase 2 construction are expected to be similar to, and marginally larger than, those described for Phase 1 for IPFs related to light, noise, port utilization, vessel traffic, the presence of structures, and climate change. The main differences between construction of Phase 1 and Phase 2 are the size of the proposed monopile foundations (13 meters versus 12 meters), the number of foundations installed (up to 89 in Phase 2, compared to up to 63 in Phase 1), and the OECC route. While impacts during Phase 2 could be marginally larger, the impact magnitudes for these IPFs would be expected to be the same as for Phase 1. The impacts of Phase 2 from IPFs related to accidental releases and cable emplacement and maintenance are discussed below.

If the applicant selects the SCV as part of the final Phase 2 design, some or all of the impacts on sea turtles from the Phase 2 OECC through Muskeget Channel may not occur, while impacts along the SCV route would occur. Impacts of SCV installation would generally be localized, short term, and temporary. Based on available information, the impacts of SCV construction on sea turtles would be similar to the impacts of Phase 2 construction without the SCV. If the SCV is selected, BOEM will provide a more detailed analysis of impacts on sea turtles in a supplemental NEPA analysis.

Accidental releases: Phase 2 WTGs would store a larger volume of fuels and oils than Phase 1 WTGs; however, the overall risk of accidental releases of hazardous materials and trash/debris would be similar to those described for Alternative A (including Phase 1). Therefore, the impacts of accidental releases during Phase 2 would be the same as Phase 1: **negligible**.

Cable emplacement and maintenance: Phase 2 cable emplacement would disturb a greater area of seafloor (732 acres, including 67 acres of dredging) than Phase 1 (COP Appendix III-T; Epsilon 2022a); however, the overall impacts of cable emplacement and maintenance from Phase 2 would be similar to those described for Phase 1. As a result, cable emplacement and maintenance from Phase 2 would have short-term, localized, **negligible** impacts on sea turtles.

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-5 in Appendix G would contribute to impacts on sea turtles through the primary IPFs of noise and the presence of structures. These impacts would primarily occur through pile driving and other sources of noise during construction, as well as change in habitat due to the presence of offshore structures. The cumulative impacts of all IPFs from ongoing and planned activities, including Alternative B, would be **moderate** and may include **moderate** beneficial impacts.

Conclusions

Impacts of Alternative B. Alternative B would have **negligible** to **moderate** impacts on sea turtles within the geographic analysis area based on all IPFs, as well as **minor** beneficial impacts from the presence of structures. Construction, operations, and decommissioning of Alternative B would introduce potential accidental releases, anchoring and gear utilization, cable emplacement and maintenance, lighting, noise, EMF, port utilization, vessel traffic, new structures, and climate change to the geographic analysis area. The presence of structures could result in habitat conversion. These IPFs could impact sea turtles to varying degrees depending on the location, timing, and species affected by an activity. Impacts from proposed Project operations would occur at lower levels than those produced during construction and decommissioning. The impacts resulting from Alternative B would range from **negligible** to **moderate** due to impact pile driving, potential UXO detonations, and vessel traffic and may also result in **minor** beneficial impacts due to the anticipated artificial reef effect from the presence of structures. Therefore, the overall impact on sea turtles from Alternative B would be **moderate** because the impact would be small, and the resource would recover completely if remedial or mitigating action were taken. The applicant may elect to pursue a course of action within the PDE that would cause less impact than the maximum-case scenario evaluated above, but doing so would not likely result in different impact ratings than those described above.

The impacts of Alternative B were similarly addressed for ESA-listed sea turtle species in the NMFS BA (BOEM 2022d). The effects determinations provided in the BA reflect BOEM’s current understanding and will be finalized during the course of ESA consultation with NMFS. Table 3.8-8 summarizes the effects determinations for the listed sea turtles present within the geographic analysis area based on the analysis provided in the BA (BOEM 2022) using the following definitions:

- **No Effect**: This is the appropriate determination when the action agency determines its Proposed Action is not expected to affect listed/proposed species or designated/proposed critical habitat.
- **May Affect, Not Likely to Adversely Affect**: This is the appropriate determination when effects on listed species are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are beneficial effects without any adverse effects. Insignificant effects relate to the size of the impact; the impact cannot be meaningfully detected, measured, or evaluated and should never reach the scale where take occurs. Discountable effects are those that are extremely unlikely to occur.

- **May Affect, Likely to Adversely Affect**: This is the appropriate determination when adverse effects that are not beneficial, insignificant, or discountable are likely to occur to listed species/critical habitat.

Table 3.8-8: Summary of Impacts Determination for Alternative B from the National Marine Fisheries Service Biological Assessment

Activity	Impact Type (IPF)	Potential Effect	Listed Sea Turtles[a]
Construction			
Inter-array and offshore export cable installation	Turbidity (presence of structures)	Foraging/prey availability	Not likely to adversely affect
Offshore export and inter-array cable installation, WTG installation	Benthic habitat loss (presence of structures)	Foraging/prey availability	Not likely to adversely affect
Steel anchor cables used on construction barges	Entanglement (presence of structures)	Injury/mortality	No effect
Impact pile driving	Noise	PTS, behavioral disturbance	Likely to adversely affect
Vibratory pile driving	Noise	PTS, behavioral disturbance	Not likely to adversely affect
Vessel traffic	Noise	PTS, behavioral disturbance	Not likely to adversely affect
	Strike (traffic)	Injury/mortality	Not likely to adversely affect
Operations			
WTG	Noise	PTS, behavioral disturbance	Not likely to adversely affect
	Accidental releases	Physiological impacts, inhalation, surfacing in the sheen	Not likely to adversely affect
	Lighting	Photoperiod disruption, attraction	Not likely to adversely affect
	Presence of structures	Habitat alteration	Not likely to adversely affect
Offshore export and inter-array cables	EMF	Impacts on orientation, migration, navigation	Not likely to adversely affect
Vessel traffic	Noise	PTS, behavioral disturbance	Not likely to adversely affect
	Strike (traffic)	Injury/mortality	Not likely to adversely affect
Decommissioning			
Removal of offshore export cable, WTG, and scour protection	Turbidity/benthic habitat loss (presence of structures)	Foraging/prey availability	Not likely to adversely affect
Vessel traffic	Noise	Behavioral disturbance	Not likely to adversely affect
	Strike (traffic)	Injury/mortality	Not likely to adversely affect
HRG and ROV for site clearance	Noise	PTS, behavioral disturbance	Not likely to adversely affect

DPS = distinct population segment; EMF = electromagnetic fields; HRG = high-resolution geophysical; IPF = impact-producing factor; NA = not applicable; PTS = permanent threshold shift; ROV = remotely operated vehicle; WTG = wind turbine generator

[a] This includes Northwest Atlantic DPS of loggerhead sea turtles, green North Atlantic DPS, Kemp's ridley, and leatherback sea turtles.

Cumulative Impacts of Alternative B. Cumulative impacts on sea turtles within the geographic analysis area would range from **negligible** to **moderate**, with **moderate** beneficial impacts from the presence of structures due to the reef effect. Considering all the IPFs together, the impacts from ongoing and planned activities, including Phase 1 and 2, would result in **moderate** impacts on sea turtles in the geographic analysis area, with **moderate** beneficial impacts. The main drivers for this impact rating are pile driving, the presence of structures, ongoing climate change, ongoing vessel traffic, and the risk of entanglement in lost fishing gear. Alternative B would contribute to the overall impact rating primarily through the temporary disturbance due to impact pile driving, vessel traffic, and permanent impacts from the presence of structures. Therefore, the overall impacts on sea turtles would likely qualify as **moderate** because a notable and measurable impact is anticipated, but the resource would likely recover completely when the IPFs are removed and/or remedial or mitigating actions are taken. Cumulative impacts would only occur where the activities of Alternative B overlap with other ongoing or planned activities (i.e., within the SWDA and OECC).

While the significance level of impacts would remain the same, BOEM is evaluating the following mitigation and monitoring measures to address impacts on sea turtles, as described in detail in Table H-2 of Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval. These measures are designed to reduce the amount and extent of ESA-listed species take related to pile-driving noise and vessel strike:

- Provide proposed Project personnel with informational training on proper storage and disposal practices to reduce the likelihood of accidental discharges;
- Minimize the amount of vessel lighting and navigation lighting on WTG and ESP foundations to reduce potential attraction to proposed Project vessels, WTGs, and ESPs;
- Implement pile-driving noise reduction technologies to achieve a reduction of noise impacts;
- Monitor pile-driving noise to ensure compliance with required noise reductions;
- Refine exclusion zones based on field measurements;
- Perform daily pre-construction surveys to ensure that marine mammals and sea turtles are not present in the area during pile driving;
- Use PSOs to establish clearance zones prior to commencing pile-driving activities;
- Use pile-driving time of day restrictions to ensure that all clearance zones are maintained;
- Implement soft-start procedures to reduce the risk of noise impacts;
- Report—daily and weekly—sea turtles observed, if any, during pile-driving operations;
- Require annual remotely operated underwater vehicle surveys, reporting, and monofilament and other fishing gear cleanup around WTG foundations;
- Require vessel strike avoidance procedures and injured/dead protected species reporting to ensure vigilance by vessel crews during transit;
- Require vessel to designate a crew person to monitor for sea turtles to avoid vessel strikes; and
- Use AIS to monitor proposed Project vessel compliance with required speed restrictions.

3.8.2.4 Impacts of Alternative C – Fisheries Habitat Impact Minimization Alternative on Sea Turtles

Alternatives C-1 and C-2 would not affect the number or placement of WTGs or ESPs for the proposed Project compared to Alternative B. Alternatives C-1 and C-2 would alter the exact routes of inter-array, inter-link, and export cables installed for the proposed Project and could, thus, affect the exact length of cable installed and area of ocean floor disturbed. While Alternatives C-1 and C-2 could have marginally different impacts on sea turtles than Alternative B, these differences would not result in meaningfully different impact magnitudes compared to Alternative B. Therefore, the overall impacts of Alternatives C-1 and C-2 on sea turtles would be the same as those of Alternative B: **moderate**, with **moderate** beneficial impacts.

3.9 Commercial Fisheries and For-Hire Recreational Fishing

3.9.1 Description of the Affected Environment

3.9.1.1 Geographic Analysis Area

This section discusses existing commercial and for-hire recreational fishing in the geographic analysis area for commercial fisheries and for-hire recreational fishing, as described in Table D-1 in Appendix D, Geographical Analysis Areas, and shown on Figure 3.9-1. 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 (3.5 to 230 miles) from the coastline—through Cape Hatteras, North Carolina, plus state waters—from 0 to 3 nautical miles (0 to 3.5 miles) from the coastline. Section B.2 in Appendix B, Supplemental Information and Additional Figures and Tables, includes detailed fisheries data compiled for Vineyard Wind 1 (BOEM 2021). These data broadly characterize and support the analysis of the proposed Project's impacts on commercial fisheries and for-hire recreational fishing.

3.9.1.2 Commercial Fishing Activities

Commercial fisheries refer to fishing activities that sell catch for profits. The regional setting extends primarily over fishing ports and waters in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey, although vessels from other ports may operate in the area. Commercial vessels active in the RI/MA Lease Areas may be homeported and/or may land product in ports in those or other states.

Commercial fisheries in the northeast United States are known for the large landings of herring, menhaden, clam, squid, scallop, skate, and lobster, as well as for being a notable source of profit from scallop, lobster, clam, squid, and other species (NOAA 2019a). The fisheries resources in federal waters off New England provide a significant amount of revenue; commercial fisheries obtain the greatest concentration of revenue from around the 164-foot depth contour off Long Island and Georges Bank (NOAA 2019a). NMFS has many regulated fishing areas across the geographic analysis area, such as the exclusion of mobile gear fishing in parts of Georges Bank for fish stock rebuilding. Overall, there is moderate revenue within and in the vicinity of the SWDA (Figure 3.9-2).

New Bedford, Massachusetts, has been the highest value-producing U.S. fishing port for 20 consecutive years, with a landings value of $451 million in 2019 (NOAA 2021c). In 2019, commercial fisheries harvested more than 1.1 billion pounds of fish and shellfish in the Middle Atlantic and New England regions, for a total landed value of over $1.9 billion (NOAA 2021c). Of that, 234 million pounds of fish and shellfish were from Massachusetts ports in 2019, for a total landed value of over $679 million (NOAA 2021c). The two most valuable Massachusetts fisheries are the sea scallop and lobster fisheries, although the lobster fishery is considered depleted, and vessels must routinely target lobster in deeper offshore waters (BOEM 2021). Since 2010, the sea scallop fishery has landed an average of 31.1 million pounds per year, worth approximately $320.2 million. Over the same period, the lobster fishery landed an average of 15.6 million pounds per year, worth approximately $70.8 million (COP Volume III, Section 7.6.1.1; Epsilon 2022a). Other important shellfish fisheries in nearshore areas of Massachusetts include a propagation program in the Town of Barnstable for northern quahogs, eastern oysters, soft shell clams, and bay scallops (COP Volume III, Section 7.6.1; Epsilon 2022a).

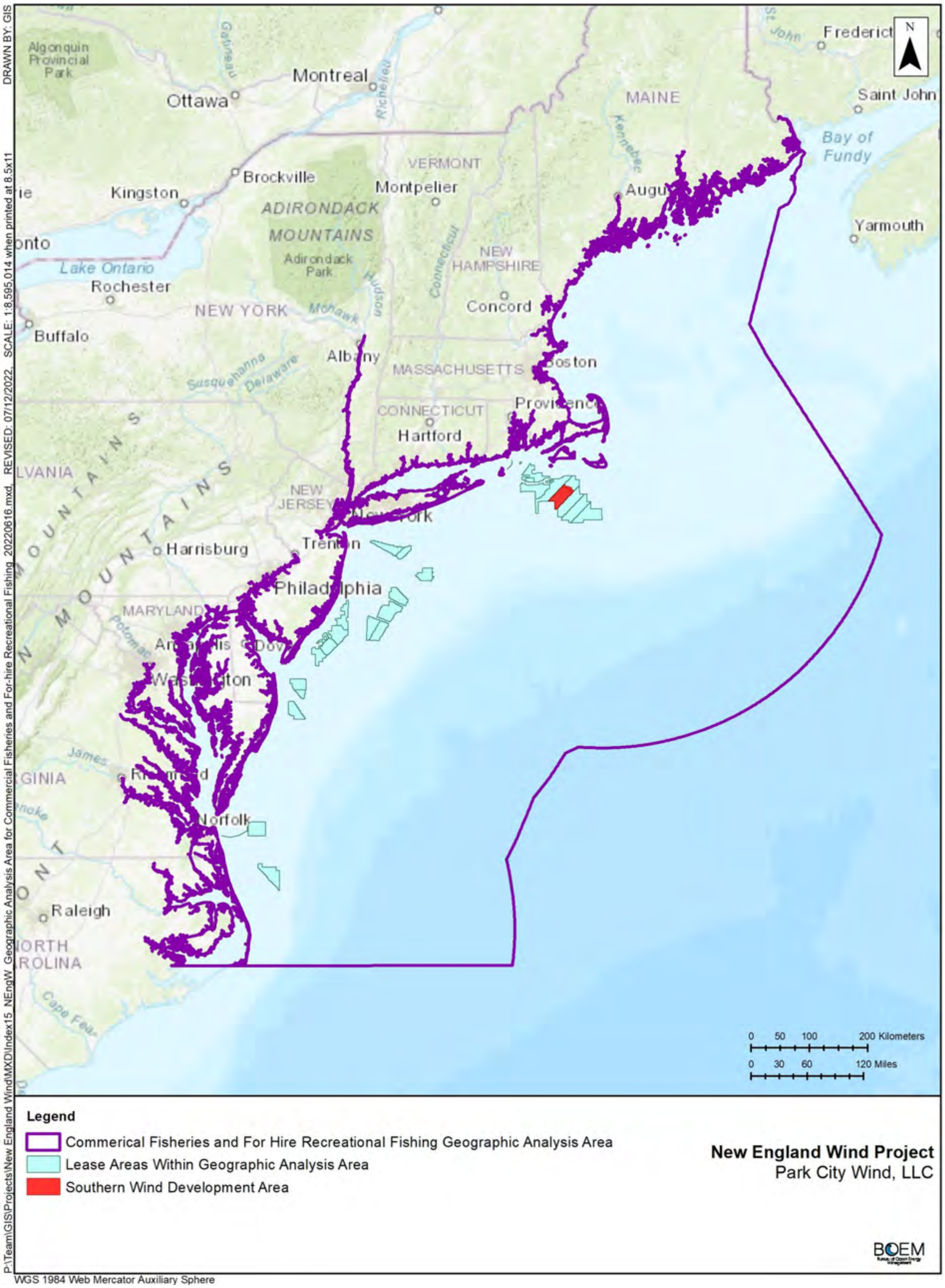
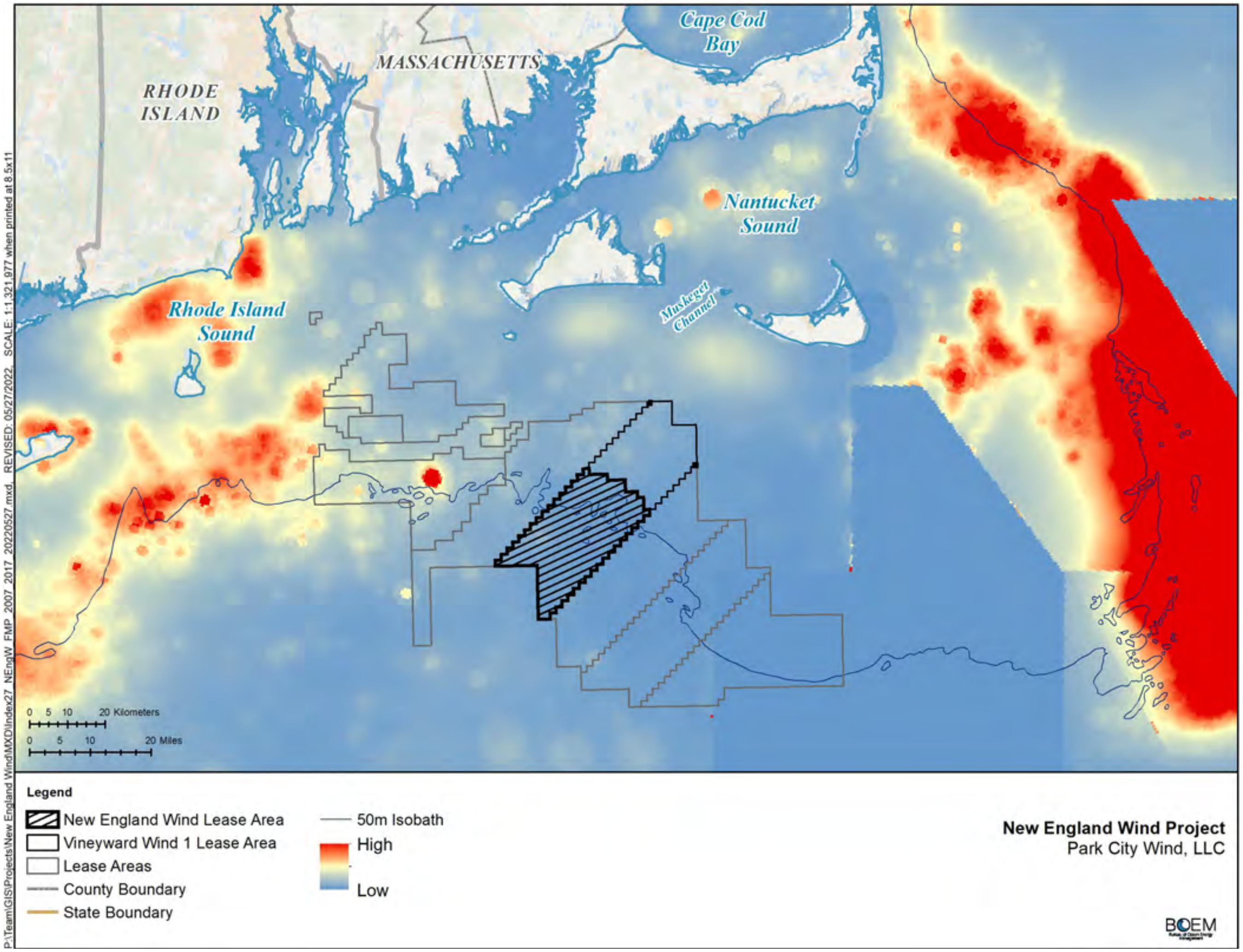


Figure 3.9-1: Geographic Analysis Area for Commercial Fisheries and For-Hire Recreational Fishing



NEFSC = Northeast Fisheries Science Center; VTR = vessel trip report
This is based on federally reported VTRs and conversion by NEFSC (G. DePiper, Pers. Comm., June 4, 2019). The top 5 percent of revenue was clipped to lessen high-value scallop revenue skew of regional revenue. Without clipping, the top 5 percent areas important to lesser value fisheries would not appear. Removing the top 5 percent does not remove any areas that are not already represented in the red (high) end of the color ramp.

Figure 3.9-2: Fishing Intensity Based on Average Annual Revenue for Federally Managed Fisheries (2007–2017)

Other important commercial fisheries in states neighboring the offshore development region (i.e., Rhode Island, Connecticut, New York, and New Jersey) include the squid, summer flounder, and Jonah crab fisheries in Rhode Island; sea scallop, squid, lobster, and whiting fisheries in Connecticut; northern quahog, squid, eastern oyster, and golden tilefish fisheries in New York; and the sea scallop, menhaden, and surf clam fisheries in New Jersey (COP Volume III, Section 7.6.1; Epsilon 2022a).

In Rhode Island, the three major commercial fishing ports include Port Judith, Newport, and North Kingstown. The busiest port is Port Judith, which typically lands squid (the highest revenue species in Rhode Island), mackerel, and butterfish (BOEM 2021). For all species, landings in Rhode Island in 2019 totaled more than 78 million pounds, for a total value of $109 million (NOAA 2021c). The major commercial fishing ports in Connecticut are New London and Stonington, with the highest revenue producing fishery being the sea scallop. New London is the largest port statewide by pounds landed and value, with total landings in 2019 of more than 9 million pounds valued at more than $16 million (NOAA 2021c). In New York, the highest revenue-producing species is the northern quahog. Two ports (Hampton Bays/Shinnecock and Montauk) are the major commercial landing sites, but commercial fishing and landings also occur at other smaller ports. Montauk is the largest New York port by pounds landed and value (all species). Statewide, total landings in 2019 were more than 23 million pounds valued at more than $39 million (NOAA 2021c). New Jersey contains the commercial fishing ports of Atlantic City, Cape May/Wildwood, Barnegat/Long Beach, and Point Pleasant, but commercial fishing vessels also operate and land catches at other New Jersey ports. New Jersey’s most important fishery is the sea scallop. Cape May/Wildwood is the largest commercial fishing port in New Jersey and was the 10th most valuable port in the United States in 2018, with landings of 102.2 million pounds valued at more than $66 million in 2018 (COP Volume III, Section 7.6.1; Epsilon 2022a). Statewide, landings totaled more than 175 million pounds valued at more than $189 million in 2019 (NOAA 2021c).

3.9.1.3 For-Hire Recreational Fishing Activities

For-hire fishing boats sell recreational fishing trips to anglers, as opposed to commercial fishing activities where boat operators sell their catch to processing houses for profit. For-hire recreational fishing is a common and economically important activity throughout the geographic analysis area, including the SWDA and the OECC. NOAA’s Marine Recreational Information Program noted that in 2020, the largest catches in Massachusetts from charter fishing vessels were striped bass and Atlantic mackerel. A total of 32,197 for-hire angler trips occurred in state and federal waters offshore Massachusetts in 2020, a large decrease from 114,702 trips in 2019 (NOAA MRIP 2021). The decrease is likely a result of the coronavirus disease 2019 (COVID-19) pandemic. From 2010 to 2020, there were an average 100,157 charter boat fishing trips out of Massachusetts and 22,893 out of Rhode Island.

For-hire recreational fishing in the Atlantic provides opportunities for recreational fishing of HMS such as tuna, billfish, swordfish, and sharks. Tuna and sharks are found in the SWDA where they feed on squid, mackerel, and butterfish found in the area. Tuna and sharks are targeted in the SWDA by for-hire fishing boats. HMS such as tuna and shark are relatively costly to pursue for private anglers, as they require large vessels.

Popular recreational fishing areas across the entire RI/MA Lease Areas include “The Dump,” where recreational vessels harvest yellowfin tuna, albacore tuna, and mahi-mahi, as well as “The Owl” and “The Star.” “31 Fathom Hole” and the northeast corner of The Dump are the only named recreational fishing locations within the SWDA (Figure 3.9-3). Species caught by recreational vessels in these areas include bluefin tuna, mako and thresher sharks, white marlin, and yellowfin tuna. Along the OECC, harvested species often include striped bass, bluefish, bonito, and false albacore, as well as summer flounder, black sea bass, and scup (COP Volume III, Section 7.6.4; Epsilon 2022a).

The greatest amount of recreational fishing effort for HMS occurred west of the SWDA in the waters south and east of Montauk Point and Block Island. Within the RI/MA Lease Areas, a large amount of fishing effort for all HMS occurred in “The Dump,” “Coxes Ledge,” “The Fingers,” and “The Claw” (Kneebone and Capizzano 2020).

3.9.1.4 Trends

Commercial fisheries and for-hire recreational fishing in the geographic analysis area are subject to pressure from ongoing activities, including presence of structures, vessel traffic, and climate change. Fisheries management impacts commercial fisheries and for-hire recreational fishing in the region through 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.

Climate change is also predicted to affect northeast United States fishery species (Hare et al. 2016), which will impact commercial and for-hire fisheries differently; some stocks may use increased habitat, and some may see habitat reduced, depending on the targeted species and the ability of fishing regulations to adapt. Changing environmental and ocean conditions (currents, water temperature, etc.), increased storm magnitude or frequency, and shoreline changes can impact fish distribution, populations, and availability to commercial and for-hire recreational fisheries. Impacts from other ongoing activities, including structures such as existing cables and pipelines, have been largely mitigated through burial of the infrastructure.

Overall trends in the status of commercial fisheries and for-hire recreational fisheries in the geographic analysis area are difficult to determine, for a variety of reasons. Commercial fisheries landings are often volatile from year to year, even when fishing activity is sustainable. The COVID-19 pandemic in 2020 and 2021 in particular has had vast implications on commercial and recreational fishing effort and landings. 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 can have significant fluctuations in how much is landed every year from within the SWDA, the Massachusetts Lease Areas, and other locations. As a result, it is challenging to predict future commercial fishing revenue from specific fishing areas, such as the RI/MA Lease Areas. However, landings and catch values have generally remained consistent between 2014 and 2018 at selected northeast United States ports in the offshore development region, with some ports showing increases in recent years (e.g., Cape May/Wildwood, New Jersey [101.2 million pounds in 2018 versus 49.9 million pounds in 2014]), and others showing decreases (e.g., New Bedford and Fairhaven, Massachusetts [116.7 million pounds in 2018 versus 146.4 million pounds in 2014]) (COP Volume III, Section 7.6.1; Epsilon 2022a). The activity and value of fisheries in recent years are expected to be indicative of future conditions and trends.

Although it is difficult to predict future trends in the overall stratus of commercial fisheries and for-hire recreational fishing in the geographic analysis area, it is expected that fisheries management regulations will continue to be assessed and modified as required to maintain the maximum sustainable yield catches.

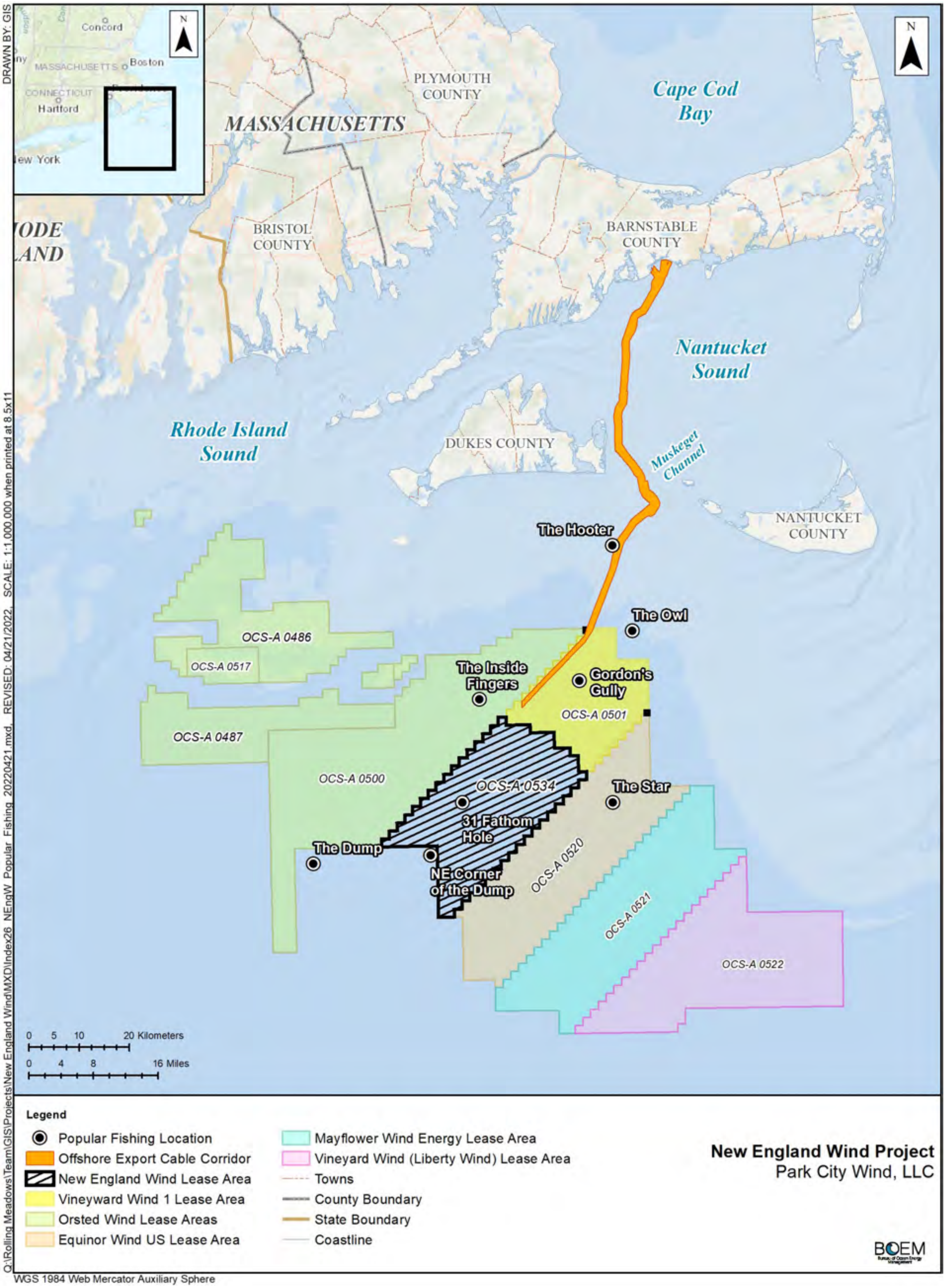


Figure 3.9-3: Popular Recreational Fishing Spots

3.9.2 Environmental Consequences

Definitions of potential impact levels for commercial fisheries and for-hire recreational fishing are provided in Table 3.9-1.

Table 3.9-1: Impact Level Definitions for Commercial Fisheries and For-Hire Recreational Fishing

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

3.9.2.1 Impacts of Alternative A – No Action Alternative on Commercial Fisheries and For-Hire Recreational Fishing

When analyzing the impacts of Alternative A on commercial fisheries and for-hire recreational fishing, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the existing conditions for commercial fisheries and for-hire recreational fishing (Table G.1.6 in Appendix G, Impact Producing Factor Tables and Assessment of Resources with Minor [or Lower] Impacts). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for commercial fisheries and for-hire recreational fishing described in Section 3.9.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on commercial fisheries and for-hire recreational fishing include regional fishing and fishery trends. The state demand for additional electricity that the proposed Project would have provided could be met by other offshore wind projects that could affect the same geographic analysis area for commercial fisheries and for-hire recreational fishing. Therefore, impacts from ongoing, future offshore wind activities, as well as future non-offshore wind activities would still occur. The impacts on commercial fisheries and for-hire recreational fishing would be similar, but the exact impact would not be the same due to temporal and geographical differences. The following analysis addresses planned offshore wind projects that fall within the geographic analysis area and considers the assumptions included in Appendix E.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than

Alternative B). Future offshore wind development activities would affect commercial fisheries and for-hire recreational fishing through the following primary IPFs.

Anchoring and gear utilization: Anchoring could pose a localized (within a few hundred feet of anchored vessels), temporary (hours to days) navigational hazard to fishing vessels. Alternative A would increase vessel anchoring during survey activities and during the construction of offshore components as a result of future offshore wind project construction from 2022 through 2030. The location and level of these impacts would depend on specific locations and duration of activities, which would not be continuous but rather intermittent based on the construction schedule of each project. BOEM assumes that anchoring disturbance for offshore wind projects would affect up to 3,776 acres of seafloor (Appendix E), out of nearly 200 million acres within the geographic analysis area. DP vessels, if used for offshore wind project construction, would reduce these impacts. In addition, the installation of met towers or buoys could increase anchoring activity. Anchoring impacts on finfish, invertebrates, and EFH are discussed in Section 3.6, and impacts on navigation and vessel traffic are discussed in Section 3.13, Navigation and Vessel Traffic.

Cable emplacement and maintenance: Cable emplacement could cause localized, short-term impacts including disrupting fishing activities during active installation and maintenance or when transmission cables are 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 of the proposed Project, the duration (1 day to several months) and extent (several feet to more than 1,600 feet during active procedures) of impacts would include temporary displacement of fishing vessels and disruption of fishing activities. Offshore, inter-array, and inter-link cable emplacement in the geographic analysis area would affect approximately 61,227 acres of seafloor (out of more than 200 million total acres); however, only a portion of that amount would be off limits to fishing vessels during Alternative A construction between 2022 and 2030. A maximum of six offshore wind projects (excluding the proposed Project) could be under construction simultaneously in 2025 (Appendix E). The impacts from a project that would overlap in cable-laying activities with a previously approved project would be assessed in additional project-specific NEPA analysis.

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. Overall, cable-laying activities would not restrict large areas, and navigational impacts would be on the scale of hours, primarily because only a fraction of the total cable emplacement area would be affected at any time. 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. Most construction activities would likely take place in the summer due to more favorable weather conditions. Thus, fisheries and fishery resources most active in the summer, such as the longfin squid fishery, would likely be impacted more than those that are most active in winter.

Climate change: Climate change affects commercial fisheries and for-hire recreational fishing, primarily through increased sea surface and bottom temperature. Warming of ocean waters has been shown to impact fish distribution in the northeast United States through the action of several species shifting the center of biomass either northward or to deeper waters. These movements have changed, and will continue to change, the distribution of commercial fishing effort, impacting commercial and recreational fishing participants and coastal communities (Hare et al. 2016; Rogers et al. 2019). Additional impacts on commercial fisheries and for-hire recreational fishing can result from climate change impacts such as increased storm magnitude or frequency and shoreline changes. Implementation of offshore wind projects would likely result in a net decrease in GHGs through displacement of energy generated by fossil fuel-type facilities. This reduction in GHG emissions from offshore wind operations would substantially outweigh any small increase in GHG emissions from offshore wind project construction. Overall, an offshore wind project alone would likely not influence climate change enough to modify its impacts on commercial fisheries and for-hire recreational fishing. Assessing climate change impacts on the marine ecosystem is a challenge because the future end-state of the ecosystem and an animal's abilities to adapt are not completely known. Renewable energy, including offshore wind, may reduce some of these impacts over time.

Noise: Noise from construction, site assessment G&G survey activities, operations, pile driving, trenching, and vessels could cause localized, temporary impacts on commercial fisheries and for-hire recreational fishing. Section 3.6 discusses noise impacts on finfish, invertebrates, and EFH in further detail.

Noise from G&G surveys of cable routes and other site characterization surveys for offshore wind facilities could affect finfish, invertebrates, and EFH but is not anticipated to rise to fishery-level impacts because survey noise would be temporary and occur intermittently during Alternative A construction between 2022 and 2030. As described in Section 3.6, Finfish, Invertebrates, and Essential Fish Habitat, G&G noise from offshore wind site characterization surveys is less intense than G&G noise from seismic surveys used in oil and gas exploration. Noise from offshore wind G&G surveys, construction, trenching, vessel activity, and WTG operations is expected to occur but would have less of an impact on finfish, invertebrates, and EFH than acoustically sensitive marine mammals (Section 3.6). This noise is expected to cause behavioral changes for commercial fish species that could impact the catch efficiency of some gear (hook and line); however, the noise from these sources is not anticipated to impact reproduction and recruitment of commercial fish stocks and would not have fishery-level impacts.

Pile driving would have the greatest noise impacts on commercial fisheries and for-hire recreational fishing. Noise from pile driving would occur during installation of foundations for offshore structures. Based on assumptions for the proposed Project, 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 two foundations per day. One or more projects may install more than one foundation per day, either sequentially or simultaneously during Alternative A construction between 2022 and 2030. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to finfish, invertebrates, and EFH in a limited space around each pile and can cause short-term stress and behavioral changes to individuals over a greater space (Section 3.6). The extent of impacts on fish and invertebrate species depends on pile size, hammer energy, and local acoustic conditions; behavioral impacts would likely extend radially up to 8.7 miles around each pile without attenuation, and the radius for injury is estimated to extend up to 515 feet from each pile (COP Appendix III-M, Section 4.5; Epsilon 2022a).

In areas where commercially harvested finfish and invertebrates experience behavioral impacts, it is anticipated that some fishing activities may experience less catch due to movement of fish away from sound sources and/or reduced catch efficiency in hook and line fisheries (Skalski et al. 1992). These impacts on fish could affect fishing activities if vessels need to temporarily relocate to other fishing locations 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 impacts is much larger than injurious impacts. If pile-driving noise were to adversely affect spawning behavior, then reduced reproductive success in one or more spawning seasons could result. This could potentially result in long-term impacts on populations and harvest levels if 1 or more years 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).

Future offshore wind projects could result in simultaneous noise-producing activities. 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 because 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. Most construction activities would likely take place in the summer due to more favorable weather conditions. Thus, fisheries and fishery resources most active in the summer would 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 discussed in the proposed Project COP (Volume III, Section 7.6.1; Epsilon 2022a). Of those major fishing ports, New Bedford, Hampton Roads, Atlantic City, Ocean City, and Montauk have been identified as possible ports capable of supporting offshore wind energy construction and/or operations. Other non-major fishing ports could also be used for operations support. Port expansions would likely happen during Alternative A construction between 2022 and 2030, 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.

Structures may alter the availability of targeted fish species in the immediate vicinity of the structures. For example, stocks of 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) previously. HMS species may also be attracted to the wind turbine foundations. 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) or refuge (increase), and increase competition between species, which could have beneficial or adverse impacts, depending on the species. These impacts are not anticipated to result in stock-level impacts that would in turn impact fisheries. As discussed in Section 3.6, estimates of the linear extent of the reef effect range from 52.5 feet (Stanley 1994) to 1,968.5 feet (Kang et al. 2011) from a structure, and Rosemond et al. (2018) have suggested assuming a distance of 98 to 197 feet as a first approximation. These impacts could lead to increased opportunities for for-hire recreational fisheries and private recreational anglers targeting structure-oriented species, which could lead to space conflicts with commercial fisheries. There would be no impact in areas that already contain natural or artificial structures. Section 3.6 includes a more detailed discussion on finfish aggregation and habitat alteration.

Future offshore wind structures are anticipated to provide forage and refuge for some migratory species, including finfish, invertebrates, and EFH (e.g., summer flounder, monkfish, black sea bass, and lobster). While these behavioral impacts 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 larger driver of seasonal migration (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018). Therefore, fishery-level impacts are not anticipated. Section 3.6 includes more details about the impacts of the presence of structures on finfish.

The presence of structures (including submarine 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 the risk of fishing gear snares and maneuverability restrictions (including risk of allisions) within individual project wind development areas, commercial fishing operators have expressed specific concerns about fishing vessels operating trawl gear that may not be able to safely deploy and operate in a wind development area given the size of the gear, the spacing between the WTGs, and the space required to safely navigate, especially with other vessels present and during poor weather conditions. Trawl and dredge vessel operators have commented that less than 1-nautical-mile (1.9-kilometer, 1.15-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 (2.3 miles) between WTGs, in alignment with the bottom contours, for safe operations (Wallace 2019). Due to mobile gear being actively pulled by a vessel over the seafloor, the chance of snagging mobile gear on proposed Project infrastructure is much greater than if—as in the case of fixed gear—the gear was set on the infrastructure or waves, or if 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 5 to 8 feet; however, BOEM assumes that up to 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 become 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. Lastly, comments from the fishing industry have included concerns that fishing vessel insurance companies may increase premiums or not cover claims for incidents within a wind energy facility if incidents/claims were to increase as a result of facility construction. At this time, it is not possible to assess the potential number of insurance claims or future decisions by private insurance companies that could result in increased premiums or loss of coverage.

Maneuverability within wind development areas would vary depending on many factors, including vessel size, fishing gear or method used, and weather conditions. Navigating through the wind development areas would not be as problematic for for-hire recreational fishing vessels, which tend to be smaller than commercial vessels and do not use large external fishing gear (other than hook and line), which makes maneuverability difficult. However, trolling for HMS (bluefin tuna, swordfish) may involve deploying many feet of lines and hooks behind the vessel, and then following large pelagic fish once they are hooked, which pose additional navigational and maneuverability challenges around WTGs. The orientation of vessels transiting and fishing within the southern New England lease areas varies by activity, fishery, and area. Figures 3.9-4 through 3.9-10 show the directionality of vessel monitoring system (VMS)-enabled fishing vessels. While these figures are from the Vineyard Wind 1 Final EIS

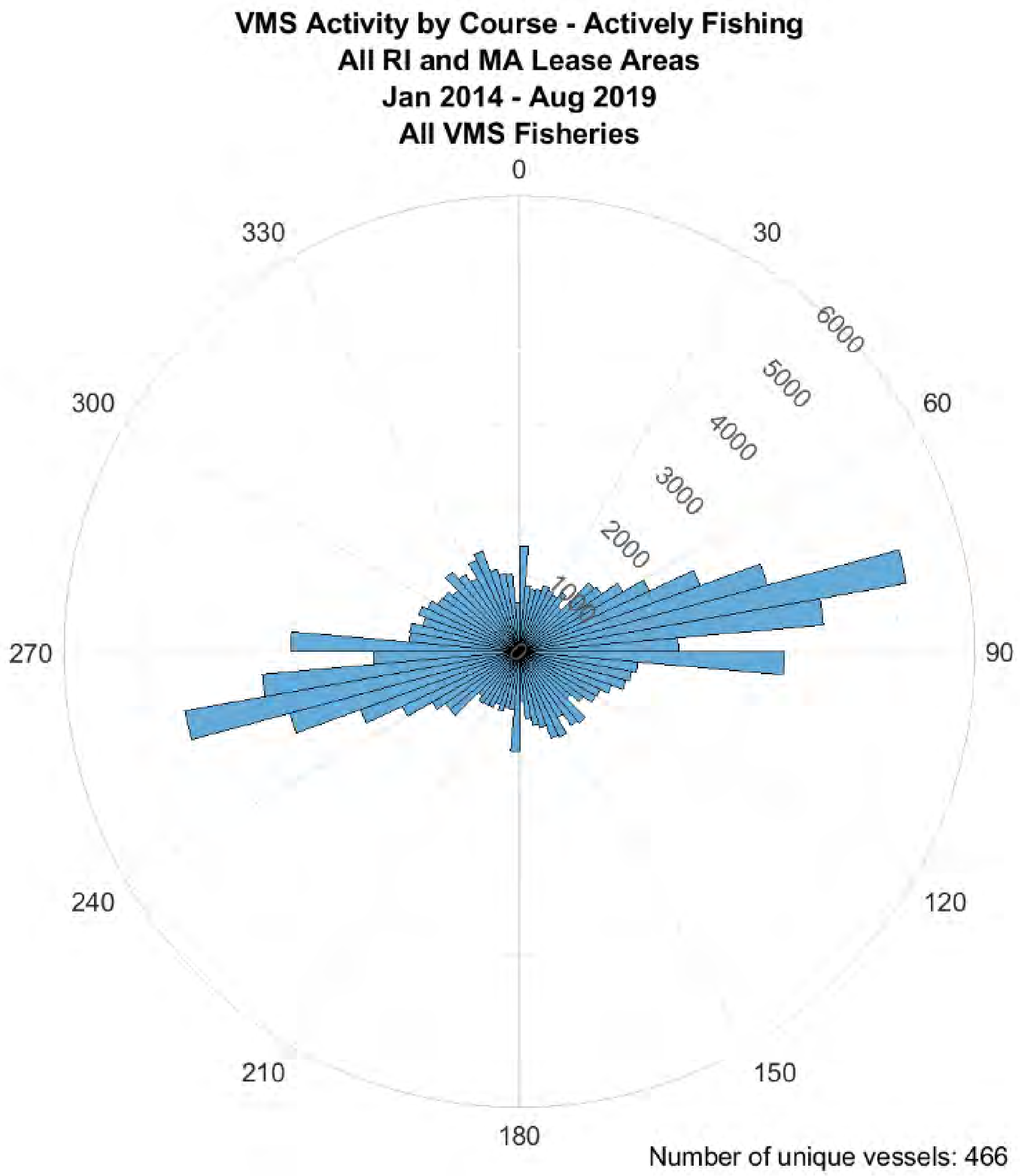
(BOEM 2021), they represent long-term trends applicable to the projects proposed under Alternative A. This analysis uses the information conveyed in each individual position report (ping), which includes all fishing vessels, parsed into two speed categories representing transiting (speeds greater than or equal to 5 knots) and fishing activity (speeds less than 5 knots).

The histograms on Figures 3.9-4 through 3.9-10 demonstrate how the orientation of vessels varies by activity, fishery, and area. The polar histograms are generated from all position reports broadcast within the RI/MA Lease Areas, including the SWDA, and represent most fishing and transit activity for fisheries with VMS requirements. Each bar includes every ping reporting a course within a 5-degree compass window (e.g., 180 to 185 degrees are represented by one bar). The longer bars represent a greater number of position reports (pings) showing fishing vessels moving in a certain direction within the RI/MA Lease Areas or the SWDA. Overall, the plots show variability among activity type, fishery, and between a single project (i.e., SWDA) versus the planned activities scenario across the entire RI/MA Lease Areas. Figures 3.9-4 and 3.9-5 show the directionality of all VMS fishing vessels across the RI/MA Lease Areas. Figure 3.9-4 shows a majority of the 466 unique fishing vessels moving in a direction 10 to 15 degrees off due east-to-west throughout the RI/MA Lease Areas. This direction is generally consistent with the former Loran lines. Figure 3.9-5 shows a majority of the 668 unique vessels transiting in a northwest-to-southeast direction through the southern New England lease areas. Figure 3.9-6 shows that the volume of actively transiting position reports (430) created within the SWDA greatly exceeds the volume of actively fishing position reports (175), indicating a stronger northwest-to-southeast direction signal. The figures demonstrate a predominantly northwest-to-southeast transit pattern and slightly northeast-to-southwest fishing pattern in the SWDA.

NMFS (2021i) prepared a summary of fishery landings and vessel revenue from the SWDA, including a description of the number of fishing vessels operating in the SWDA region. In 2019, there were 180 fishing vessels operating in the SWDA. Of these 180 vessels, the most targeted species included summer flounder (targeted by 59 percent of vessels), monkfish (targeted by 57 percent of vessels), and black sea bass (targeted by 53 percent of vessels) (NMFS 2021i). Individual vessels often target more than one species.

The USCG Final MARIPARS evaluated the need for establishing vessel routing measures, and recommended all surface structures be aligned in a 1-nautical-mile (1.15-mile) × 1-nautical-mile (1.15-mile) grid, such that vessels anywhere in the RI/MA Lease Areas would pass a WTG on either side every 1 nautical mile (1.15 miles) when traveling north-to-south or east-to-west, and every 0.6 nautical mile (0.69 mile) to 0.8 nautical mile (0.92 mile) when traveling northwest-to-southeast or northeast-to-southwest (USCG 2020). The final MARIPARS did not recommend implementation of any formal routing measures.

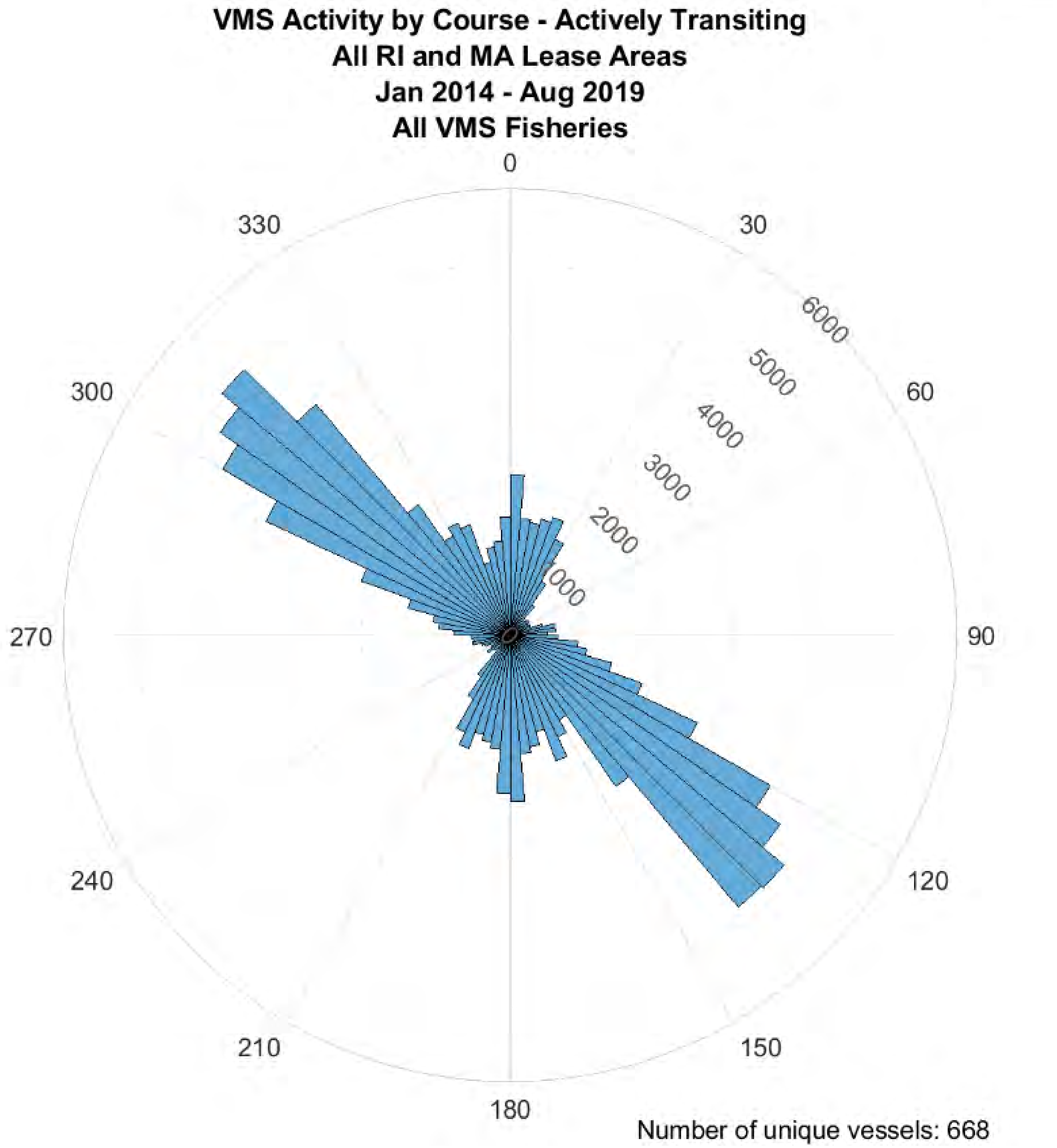
Installation of offshore cables for each offshore wind energy facility would require temporary re-routing of all vessels, including commercial and for-hire recreational fishing vessels, away from areas of active construction. During operations, periodic cable maintenance and repair could have similar impacts, although these activities would be less frequent and extensive than installation.



Source: BOEM 2021

RI and MA Lease Areas = Rhode Island and Massachusetts Lease Areas; VMS = vessel monitoring system

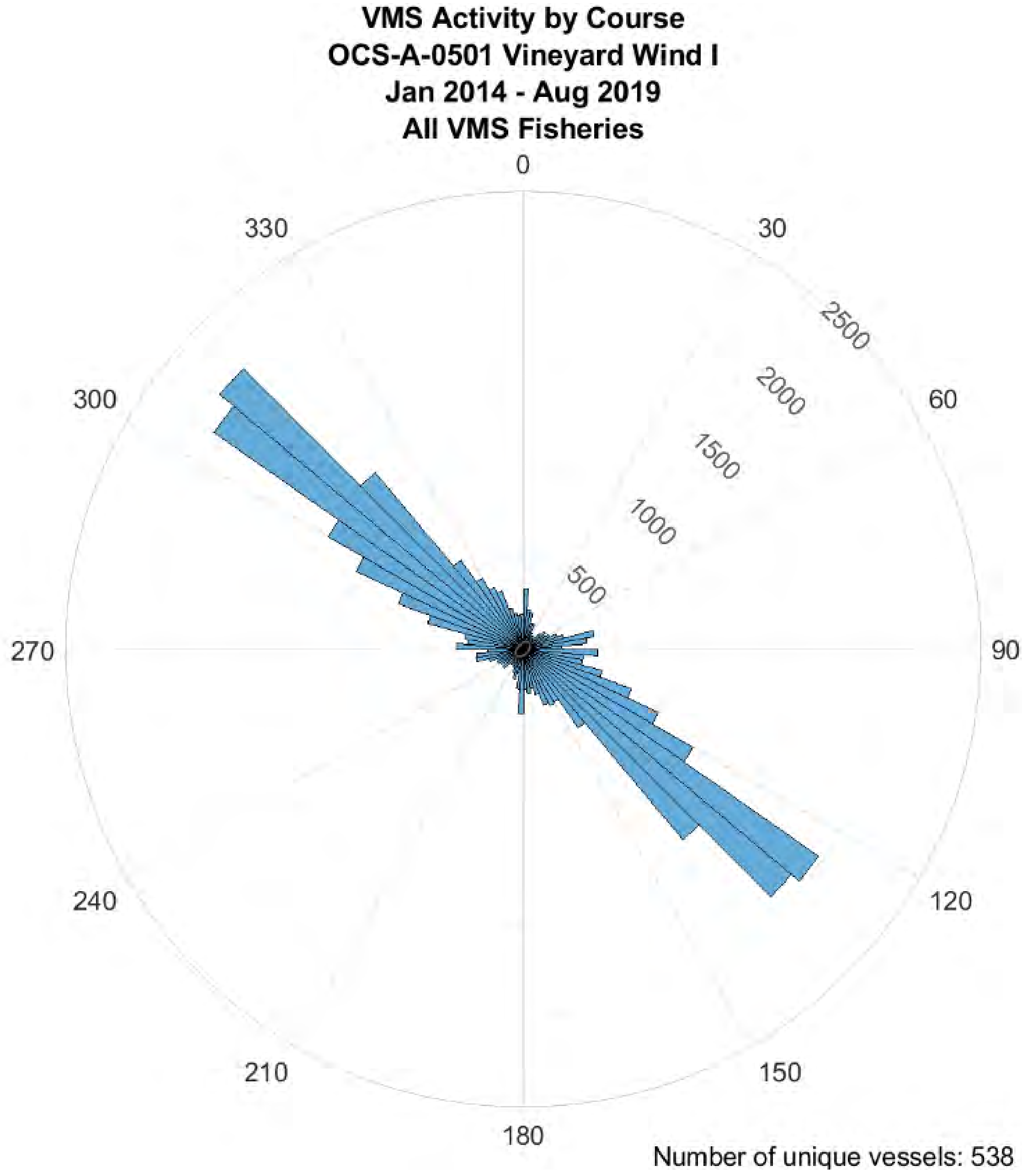
Figure 3.9-4: All Vessel Monitoring Service Fisheries in the Rhode Island/Massachusetts Lease Areas, Fishing



Source: BOEM 2021

RI and MA Lease Areas = Rhode Island and Massachusetts Lease Areas; VMS = vessel monitoring system

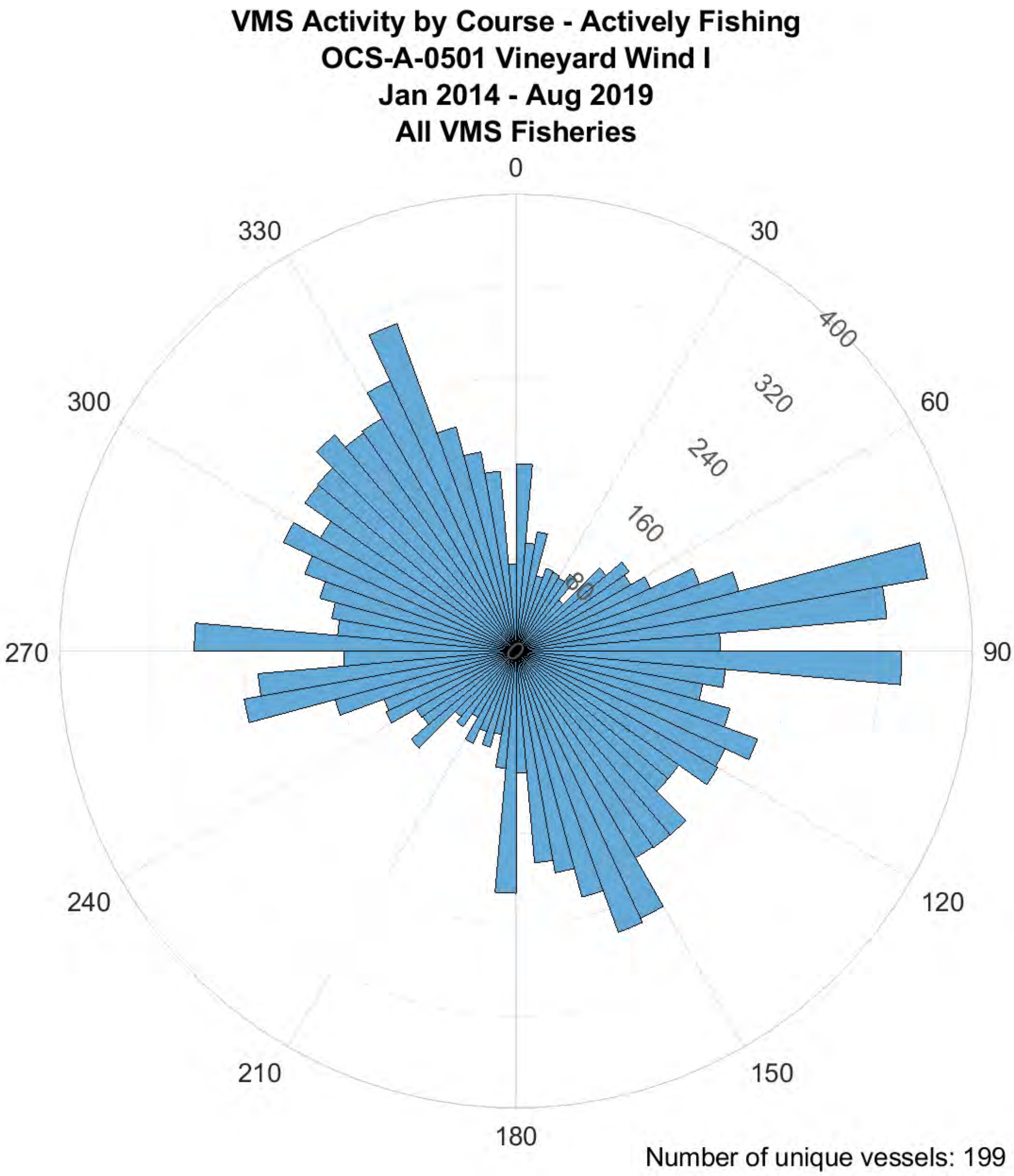
Figure 3.9-5: All Vessel Monitoring Service Fisheries in Rhode Island/Massachusetts Lease Areas, Transiting



Source: BOEM 2021

VMS = vessel monitoring system

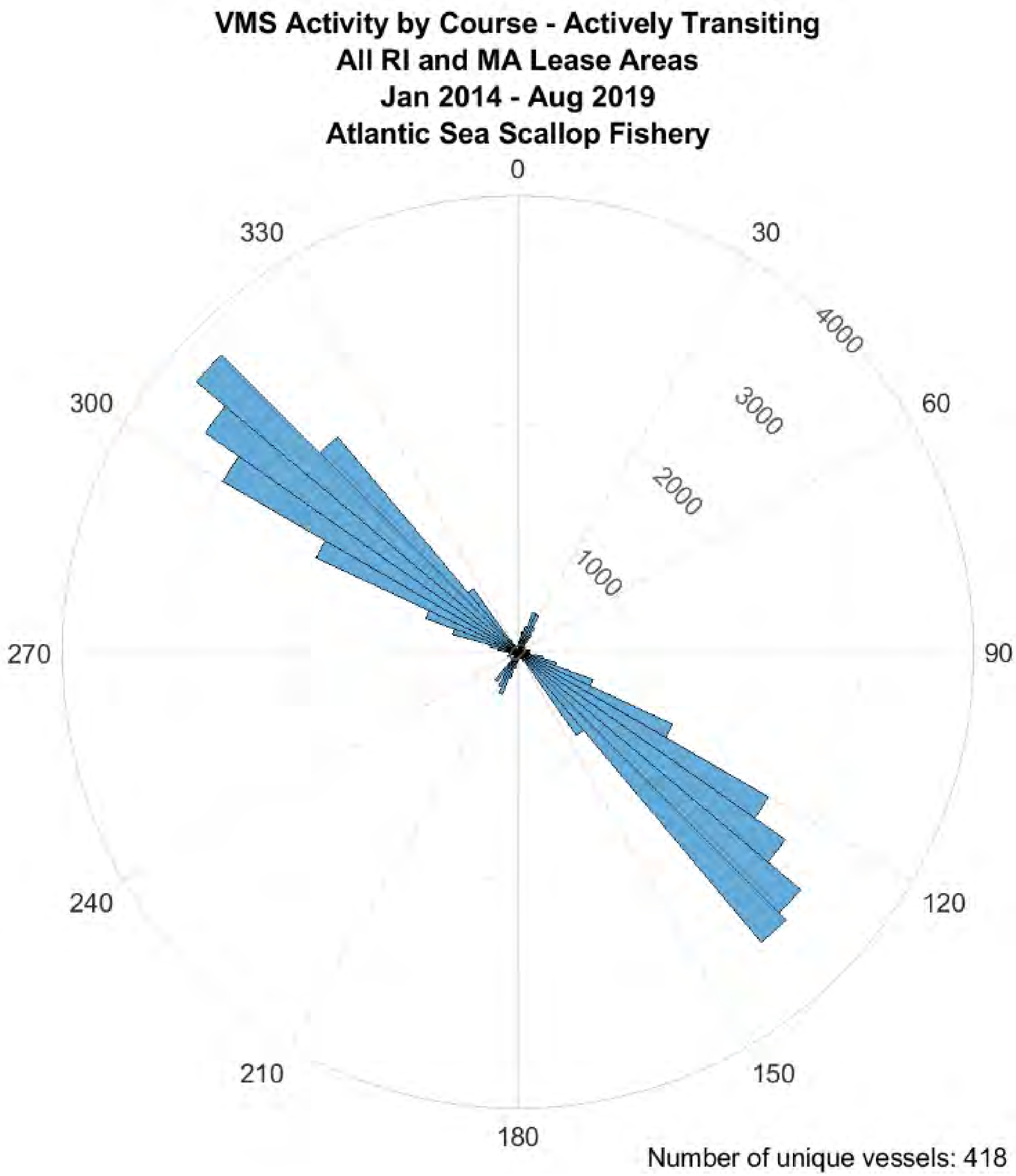
Figure 3.9-6: All Vessel Monitoring Service Fisheries in the Vineyard Wind 1 Wind Development Area, Fishing and Transiting



Source: BOEM 2021

VMS = vessel monitoring system

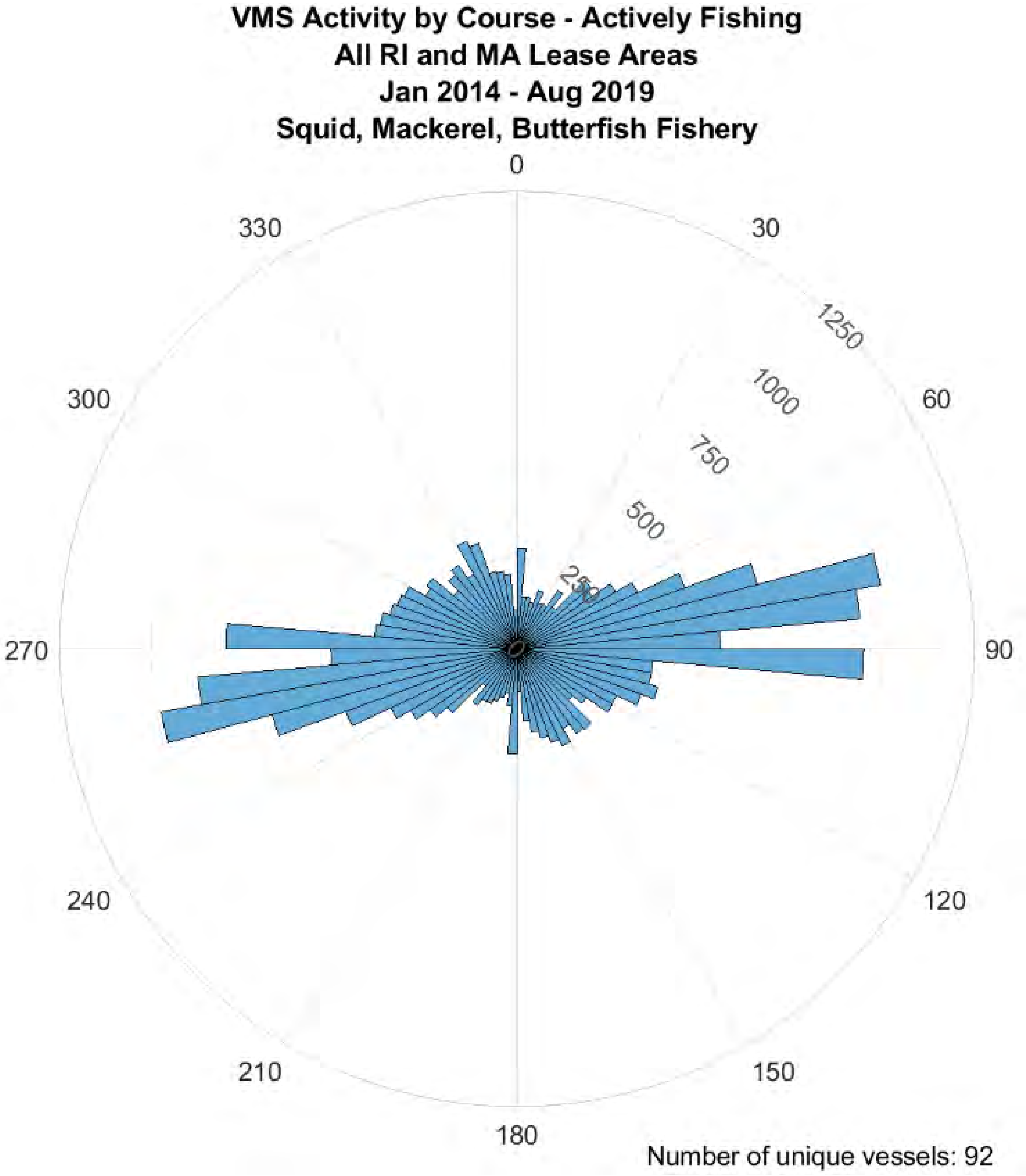
Figure 3.9-7: All Vessel Monitoring Service Fisheries in the Vineyard Wind 1 Wind Development Area, Fishing



Source: BOEM 2021

RI and MA Lease Areas = Rhode Island and Massachusetts Lease Areas; VMS = vessel monitoring system

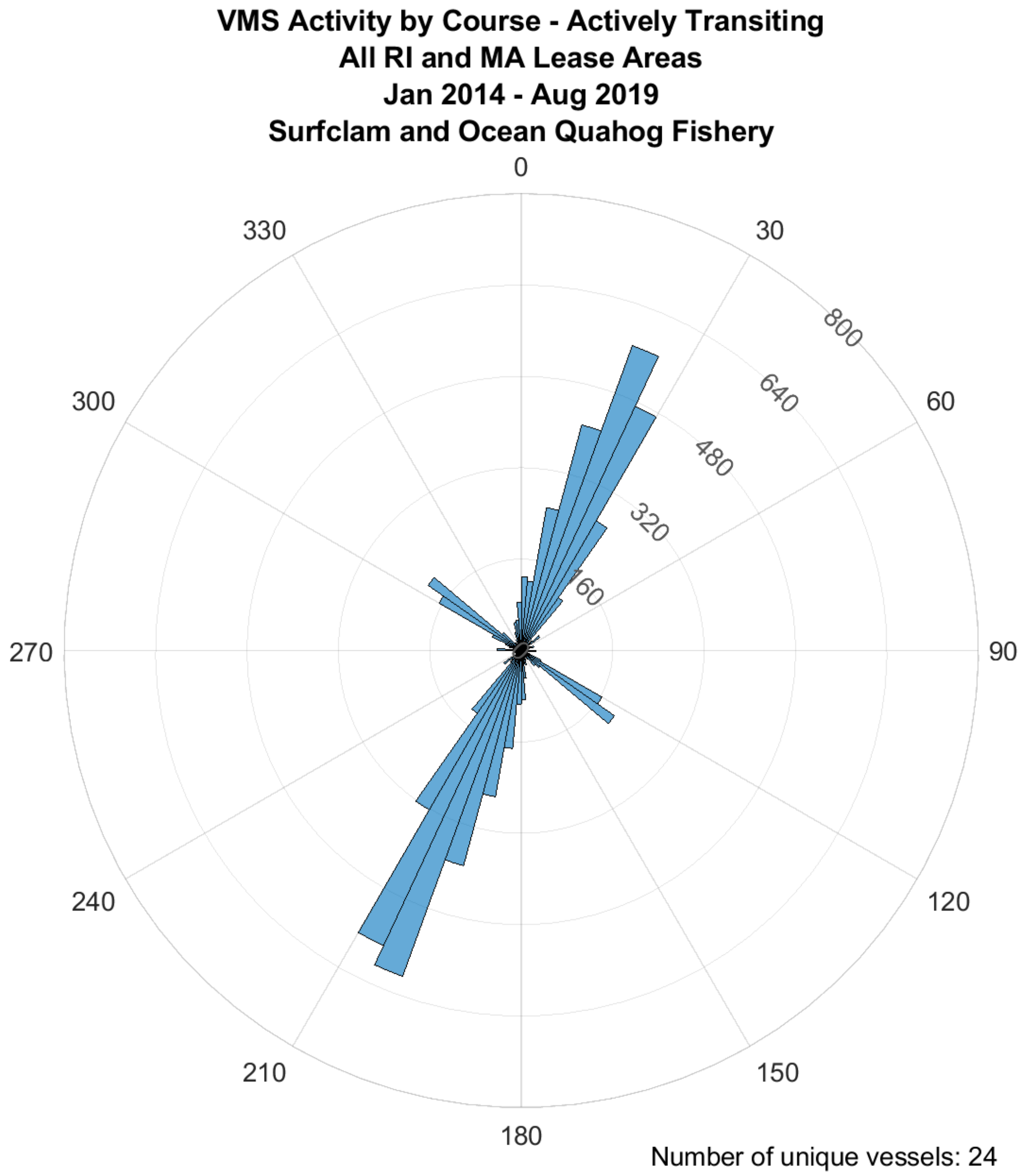
Figure 3.9-8: Sea Scallop Fishery in Rhode Island/Massachusetts Lease Areas, Transiting



Source: BOEM 2021

RI and MA Lease Areas = Rhode Island and Massachusetts Lease Areas; VMS = vessel monitoring system

Figure 3.9-9: Squid, Mackerel, Butterfish Fishery in the Rhode Island/Massachusetts Lease Areas, Fishing



Source: BOEM 2021

RI and MA Lease Areas = Rhode Island and Massachusetts Lease Areas; VMS = vessel monitoring system

Figure 3.9-10: Surf Clam and Ocean Quahog Fishery in the Rhode Island/Massachusetts Lease Areas, Transiting

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 impacts on commercial fisheries and for-hire recreational fishing. In 2017, there were 4,300 federally permitted vessels operating in the Northeast across all fisheries (NOAA 2019b). Alternative A would impact all fisheries and all gear types. 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 because 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 wind development areas could increase conflict among commercial fishing interests as other areas are encroached. The competition is expected to be higher for less mobile species such as lobster, crab, surf clam/ocean quahog, and sea scallop.

Revenue exposure, which quantifies the dockside value of fish reported as being caught in individual wind development areas, is one lens for understanding the level of commercial fishing activity that could be impacted. 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 a wind development area, as well as the availability of target species within the wind development 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 3.9-2 was included in the Ocean Wind 1 Draft EIS (BOEM 2022e) and is applicable to the proposed Project. Using the assumed construction schedule, Table 3.9-2 shows the projected annual total Northeast fishery revenue exposed, by fishery management plan for 2021 through 2030.

Table 3.9-3 shows the annual port revenue from the SWDA (from 2008 to 2019) of the ports that are anticipated to be impacted (by revenue) from the planned activities scenario. The four landing port groups with the highest average annual revenue from the SWDA are Point Judith, Rhode Island; New Bedford, Massachusetts; Montauk, New York; and Fairhaven, Massachusetts. 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.

Table 3.9-2: Annual Commercial Fishing Revenue in the Mid-Atlantic and New England Regions Exposed to Offshore Wind Energy (Excluding Proposed Project) Development by Fisheries Management Plan, 2021–2030 (thousands)

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

Sources: Adapted from BOEM 2022e

FMP = Fisheries Management Plan; HMS = highly migratory species; VTR = vessel trip report
[a] This column represents the total average revenue exposed in 2030 in order to give a value reference for the percentage of revenue exposed in 2030.
[b] This includes revenues from all species not assigned to an FMP including American lobster and Jonah crab fisheries.
Revenue is in nominal dollars using the monthly, not seasonally, adjusted Producer Price Index by Industry for Fresh and Frozen Seafood Processing provided by the U.S. Bureau of Labor Statistics. The data represent the revenue-intensity raster developed using fishery-dependent landings' data. To produce the data set, 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. Resolution of the data allows estimates to be made on a small enough scale to differentiate impacts along wind farm export cable corridors. Therefore, estimates only pertain to individual offshore wind lease areas. This provided a spatial footprint of fishing activities by FMPs. The percentages are expected to continue after 2030 until facilities are decommissioned. Slight differences in totals are due to rounding.
"$0" indicates the value is positive but less than $100.

Table 3.9-3: Average Annual Revenue from the Southern Wind Development Area for Most Impacted Ports, 2008–2019

State Landed	Port Landed	Average Annual Revenue from the SWDA
Rhode Island	Point Judith	$150,167
Massachusetts	New Bedford	$137,917
New York	Montauk	$29,583
Massachusetts	Fairhaven	$25,833
Massachusetts	Chatham	$19,250
Rhode Island	Little Compton	$16,833
Massachusetts	Westport	$12,000
Connecticut	New London	$10,917
Rhode Island	Newport	$10,417
Massachusetts	Harwich Port	$5,083

Source: Adapted from NMFS 2022

SWDA = Southern Wind Development Area

The results in Table 3.9-2 show increased revenue exposure as more offshore wind energy facilities are developed in the Mid-Atlantic and New England regions by FMP fishery from 2021 through 2030. The largest annual impacts in terms of exposed revenue are expected to be in the sea scallop, mackerel/squid/butterfish, and surf clam/ocean quahog FMP fisheries. The fishery with the largest combined percent exposure and dollar value is the sea scallop fishery, which has an estimated landing value of approximately $22.4 million. This analysis includes the SWDA and all lease areas within the expanded planned activities 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 31 percent (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 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., March 18, 2020).

Regulated fishing effort refers to fishery management measures necessary to maintain maximum sustainable yield under the MSA. This includes quota and effort allocation management measures. The structures installed as part of offshore wind development could influence regulated fishing effort 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 (Section 3.14, Other Uses [National Security and Military Use, Aviation and Air Traffic, Offshore Cables and Pipelines, Radar Systems, Scientific Research and Surveys, and Marine Minerals]). 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 processes. 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.

Traffic: Increased vessel traffic associated with future offshore wind development could increase congestion, delays at ports, and the risk for collisions with fishing vessels. In 2019, 180 fishing vessels reported trips from the SWDA, down from a maximum of 241 in 2017 (NMFS 2020). 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 for Alternative A between 2022 and 2030, particularly when future offshore wind project construction activities overlap. The presence of construction vessels could restrict harvesting activities in wind development areas and along cable routes during installation and maintenance activities.

Conclusions

Impacts of Alternative A. Under Alternative A, commercial fisheries and for-hire recreational fishing would continue to follow current regional trends and respond to current and future environmental and societal activities. While the proposed Project would not be built under Alternative A, ongoing activities would have continuing temporary to permanent impacts on commercial fisheries and for-hire recreational fishing, primarily through cable emplacement and maintenance, pile-driving noise, the presence of structures, and ongoing climate change. The extent of impacts on commercial fisheries and for-hire recreational fishing would vary by fishery due to different target species, gear type, and location of activity. The impacts of ongoing activities would be **moderate** to **major**.

Cumulative Impacts of Alternative A. In addition to ongoing activities, planned activities may also contribute to impacts on commercial fisheries and for-hire fishing. Planned activities other than offshore wind include increasing vessel traffic, new submarine cables and pipelines, marine surveys, marine minerals extraction, and port expansion activities. The combination of ongoing activities and planned activities other than offshore wind would result in **moderate** to **major** impacts on commercial fisheries and for-hire recreational fishing, primarily driven by the ongoing factors of presence of structures and climate change.

Considering all the IPFs together, the overall impacts of Alternative A would result in **major** impacts on commercial fisheries and **moderate** impacts on for-hire recreational fishing due to the presence of structures (gear loss, navigational hazard, and space use conflicts). The majority of future offshore structures in the geographic analysis area would be attributable to the offshore wind industry. The future offshore wind industry would also be responsible for the majority of impacts related to cable emplacement and maintenance and pile-driving noise. However, ongoing impacts resulting from the presence of structures—including changes to stock levels due to ongoing fishing mortality—climate change, and other factors, would continue to be one of the most impactful IPFs controlling the sustainability of commercial and for-hire fisheries in the geographic analysis area.

3.9.2.2 Relevant Design Parameters and Potential Variances in Impacts

The following proposed Project design parameters (Appendix C, Project Design Envelope and Maximum-Case Scenario) would influence the magnitude of the impacts on commercial and for-hire recreational fisheries:

- The number and type/size of foundation used for the WTGs and ESPs. The applicant could construct a maximum of 130 WTGs using monopile foundations (maximum 39 feet diameter) and 5 ESPs using 3 to 12 piles.
- The export cable landfall has the potential to interfere with nearshore fishing grounds during construction.
- The route of the inter-array cables and the offshore export cable, including the ability to reach target burial depth or use cable protection measures when burial is insufficient. The applicant anticipates that up to 10 percent of cables may not achieve the proper burial depth and would require cable protection that could change fish habitat (soft-bottom habitat to hard-bottom habitat) and could also damage fishing gear and equipment, which in turn could cause a potential safety hazard should gear snag or hook seabed structures.
- The total amount of long-term habitat alteration from scour protection for the foundations.

- The number and types of vessels used during installation, operations, and decommissioning.
- Installation methods chosen, the amount of dredging (if any), and the duration of installation.
- The time of year during which construction occurs. For-hire recreational fisheries are most active when the weather is more favorable, while commercial fishing is active year-round with many species harvested throughout the year. However, certain fisheries have peak times. Construction activities can affect access to fishing areas and availability of fish in the area, thereby reducing catch and fishing revenue.

3.9.2.3 Impacts of Alternative B – Proposed Action on Commercial Fisheries and For-Hire Recreational Fishing

This section identifies the potential impacts of Alternative B on commercial fisheries and for-hire recreational fishing.

Impacts of Phase 1

Phase 1 would affect commercial fisheries and for-hire recreational fishing through the following primary IPFs during construction, operations, and decommissioning. The impacts of Phase 1 operations would be the same as (or less than, but with the same impact magnitudes) as Phase 1 construction, except where specifically discussed below. Except where discussed for the presence of structures IPF below, the impacts of Phase 1 decommissioning would be similar to Phase 1 construction.

Anchoring and gear utilization: Vessel anchoring would cause temporary impacts on fishing vessels and fishing activities. Anchoring vessels (including jack-up and grounding) used in the course of Phase 1 would pose a navigational hazard to fishing vessels and disturb approximately up to 178 acres (COP Appendix III-T, Tables 2 and 5; Epsilon 2022a). All impacts would be localized, and potential navigation hazards would be temporary (hours to days). The impacts on commercial fisheries and for-hire recreational fishing of anchoring under Phase 1 would be **minor**. Anchoring impacts on finfish, invertebrates, and EFH are discussed in Section 3.6.

Cable emplacement and maintenance: For export cable installation, the applicant would use a cable-laying vessel or barge to transport and install the export cable. The applicant would use a pre-lay grapnel run to locate and clear obstructions prior to cable laying. The applicant might also dredge to remove sand waves along the OECC. These activities would require communications with fixed-gear fisheries to ensure no gear is deployed in the installation path. The bottom-trawl fishery provides the highest revenue from the SWDA, followed by fixed-gear fisheries including gillnet and pot (COP Volume III, Tables 7.6-9 and 7.6-12; Epsilon 2022a). Fishing revenue from gillnet and pots from the SWDA is estimated at $1,946,174 for the period of 2008 to 2019, with 7,426,706 landed pounds from the area (an average of $569,360 and 618,892 pounds per year) (COP Volume III, Section 7.6.2.3; Epsilon 2022a). During the construction activities, it may not be possible to deploy fixed gear in parts of the SWDA, which may result in the loss of revenue if alternative fishing locations are not available. In addition, temporary limitations to fishing activities for all gear types could occur along the OECC while the site is being prepared and cables laid. The applicant would communicate where and when activities would occur in the OECC to avoid conflicts with fishing activities. The applicant considers cable burial a priority and would use iterative analyses of survey data, advanced burial techniques, and micro-routing to maximize burial and minimize the need for cable protection (Epsilon 2018). The applicant may also engage with the fishing industry to determine which form of cable armoring (i.e., rock placement, concrete mattresses, and/or halfshell) would be the least likely to create new hangs for mobile gear.

In response to a request from the MA DMF, the applicant has agreed to avoid cable laying activities in the spring season (April through June) within Nantucket Sound waters in light of high concentrations of fishing activities (squid, whelk, and flounder fisheries) and natural resource events (spawning and egg laying). Thus, the applicant would conduct cable laying of nearshore segments from early September to late October (from the landfall site to the northeast portion of Martha's Vineyard) using simultaneous lay and bury.

Phase 1 would disturb up to 442 acres of the seafloor through cable installation and up to 52 acres from dredging (COP Appendix III-T, Tables 2 and 5; Epsilon 2022a). Construction of Phase 1 could prevent deployment of fixed and mobile fishing gear in limited parts of the SWDA from 1 day 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. Phase 1 would result in localized, temporary, and **minor** impacts.

Section 2.3 describes the non-routine cable maintenance activities associated with Phase 1. These activities, if they were to occur, would generally require temporary activity to address emergency conditions. To perform maintenance and inspections, an SOV would be used to provide offshore accommodations and workspace for workers. CTVs would be used to transport crew to and from shore. If an SOV is not used, which is less likely, several CTVs and helicopters would be used for crew transportation.

The offshore export cables and inter-array cables would be monitored through distributed temperature sensing equipment. The distributed temperature sensing system would be able to provide real-time monitoring of temperature along the OECC, alerting the applicant should the temperature change, which could be the result of scouring of material and cable exposure. If cable repairs are needed, support vessels such as a jack-up vessel may be used. As such, only cable repairs (if required) under this IPF would temporarily impact commercially important fish and invertebrate species, and only in a localized area immediately adjacent to the repair. Commercial and for-hire recreational fishing vessels would be temporarily excluded from the area undergoing repair. Assuming repairs would be infrequent and would affect only small segments of the cables, impacts on commercial fisheries and for-hire recreational fishing from cable repairs would be **negligible**.

Climate change: Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters and shifting species distributions, influencing the distributions of commercial and for-hire recreational fisheries. Ocean acidification has impacts on the settlement and survival of shellfish (PMEL 2020) and would contribute to potential alterations in finfish migration patterns or reductions in invertebrate populations for species with calcareous shells. These impacts could lead to changes in migratory patterns, timing, available fisheries resources, and prey abundance and distribution. The intensity of impacts resulting from climate change are uncertain but are likely to be **minor** to **moderate**.

Noise: Noise from G&G surveys, pile driving related to WTG and ESP installations, cable burial or trenching, and from vessels may occur during Phase 1. Noise can temporarily disturb finfish and invertebrates in the immediate vicinity of the source, 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 (i.e., up to 6 hours per day, intermittently, for up to 78 days between May and December [COP Appendix III-M; Epsilon 2022a]) and corresponding impacts on fish species, coinciding with fishing, and would be **negligible** to **minor** from Phase 1. Noise impacts on finfish, invertebrates, and EFH are discussed in Section 3.6.

To reduce noise impacts during construction, the applicant would use noise reduction technologies during all pile-driving activities to achieve a required minimum attenuation (reduction) of 6 dB re 1 μPa. The applicant would also use PAM to monitor and record marine mammal vocalizations and monitor

Phase 1 noise including vessel noise, pile driving, and WTG operation (Appendix H, Mitigation and Monitoring).

Port utilization: Phase 1 construction would use numerous ports in Massachusetts, Rhode Island, Connecticut, and beyond (Section G.2.7, Land Use and Coastal Infrastructure), but the applicant has not funded or otherwise prompted any specific expansions. Phase 1 vessel activity would add to existing activity in existing ports and waterways. Therefore, port utilization during Phase 1 construction would have **minor** to **moderate** impacts on commercial fisheries and for-hire recreational fishing.

Presence of structures: The type and likelihood of impacts on commercial fisheries and for-hire recreational fisheries during Phase 1 construction would be similar to the impacts described for construction of Vineyard Wind 1. Analysis from the Vineyard Wind 1 Final EIS (BOEM 2021) is summarized here, as updated to reflect details of the proposed Project. Some structures would be present during Phase 1 construction activities as WTGs and ESPs are installed. This IPF is discussed in detail below.

Commercial and recreational regulations for finfish and shellfish, implemented and enforced by NMFS and coastal states, affect how commercial and for-hire recreational fisheries operate. FMPs 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. During construction, 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 3.9.2.1. The extent of impacts from Phase 1 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. Fishing regulations may have less flexibility in area-based management due to Phase 1, and offshore wind may change the distribution of fishing effort in ways not contemplated in FMPs. Additionally, impacts on fisheries scientific surveys may result in more conservative quota and effort management measures.

The presence of structures can lead to impacts on commercial and for-hire recreational fisheries through navigation hazards and allisions, entanglement and gear loss/damage, fish aggregation, habitat conversion, migration disturbances, space use conflicts, and effort displacement. The total area of construction seafloor disturbance from structures, scour protection, and cable installations for Phase 1 is 551 acres, including 35 acres of cable protection, and temporary deployment of one or more meteorological oceanographic (metocean) buoys in up to 50 locations within the SWDA and OECC (COP Appendix III-T, Tables 2 and 5; Epsilon 2022a).

An allision occurs when a moving vessel strikes a stationary object, such as a WTG, ESP, or metocean buoy. The addition of Phase 1 WTGs, ESPs, and met buoys would increase navigational complexity, the risk of navigation hazards, and the potential for collisions and allisions for vessels transiting through the SWDA. Fishing vessels that choose to operate within the SWDA would have increased risk of allisions due to reduced maneuverability when fishing gear is deployed. Maneuverability within the SWDA would vary depending on many factors (e.g., vessel size, gear or method used, environmental conditions). Larger commercial fishing vessels with mobile gear are the most at risk for an allision, as they are the most limited in maneuverability.

Fishing in the SWDA would not be as problematic for for-hire recreational fishing vessels that bottom-fish with hook and line gear because these vessels generally operate over a fixed location or under a controlled drift. However, fishing for HMS may involve troll gear using many feet of lines and hooks behind the vessel, and in turn following large pelagic fish once they are hooked; these activities pose additional maneuverability challenges when structures are present. The risk of allisions would be mitigated through navigational lighting requirements and AIS transponders on foundations. The potential changes in fishing vessel transit routes or availability of fishing grounds due to the presence of structures could have long-term and **moderate** impacts on commercial fisheries and for-hire recreational fishing due to increased navigation time, increased fuel costs, and/or displacement from prime or preferred fishing grounds.

Commercial and recreational fishing gear is periodically lost due to entanglement with buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb habitats and potentially harm individuals, creating small, localized, temporary impacts on fish, invertebrates, and habitat but likely no impacts at a fishery level. The proposed new structures would increase the risk of gear loss/damage by entanglement and could affect fishing vessels differently depending on the size of the vessel and the fishing gear. The extent of the impacts would depend on the vessel size, the fishing gear, and foundation or cable protection 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). Vessels towing bottom-trawl gear, a common technique for squid fisheries, would also be vulnerable to areas of cable protection (Section B.2 in Appendix B). Gear loss and damage would have a **moderate** impact on commercial fisheries and a **minor** impact on for-hire recreational fishing, as the impacts would be localized to known/charted infrastructure. However, the risk of impacts would persist for as long as the structures remain.

Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon vertical relief that aggregates structure-oriented fishes. These impacts are localized and can be temporary to permanent (as long as structures are in place). Fish aggregation may be considered adverse, beneficial, or neutral. Commercial and for-hire recreational fishing can occur near these structures. However, commercial mobile fishing gear risks snagging on the structures while trying to take advantage of this aggregation. The proposed new infrastructure would modify existing soft-bottom habitat and to a lesser extent hard-bottom habitat. Structure-oriented species would benefit (e.g., lobster, striped bass, black sea bass, scup, 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 also result in increased space use conflicts between and within commercial and recreational fishing operations. These impacts would be both beneficial and adverse, likely resulting in **minor** impacts on commercial fisheries, **negligible** to **minor** impacts on for-hire recreational fisheries, and **minor** beneficial impacts on commercial and recreational fishery resources. Impacts are expected to be local to the individual foundations and may be temporary to permanent (for as long as foundations are present).

Human-made structures in the marine environment (e.g., shipwrecks, artificial reefs, buoys, and oil platforms) can attract finfish, invertebrates, and EFH that approach the structures during migration. This could slow species migrations (Section 3.6). Foundations would remain for the life of the proposed Project, and scour/cable protection would likely permanently remain. However, temperature is expected to be a larger driver of habitat occupation and species movement (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded. Therefore, this impact would be **negligible** on commercial and for-hire recreational fishery resources.

The location of proposed offshore wind projects would affect the accessibility and availability of fish for commercial and for-hire recreational fishing. In particular, the location of the proposed infrastructure within the SWDA could impact transit corridors and access to preferred fishing locations. Depending on the width and location of transit corridors through, or routes around, the SWDA, commercial and for-hire recreational fishing fleets may find it more challenging to safely transit to and from homeports as there may be less space for maneuverability and greater risk of allision or collision if there is a loss of steerage.

Transiting through the SWDA could also create challenges associated with using navigational radar when there are many radar targets that may obscure smaller vessels and where radar returns may be duplicated under certain meteorological conditions like heavy fog (Section 3.13 provides a more detailed evaluation of impacts on marine vessel radars). Larger vessels may find it necessary to travel around the SWDA to avoid maneuvering among the WTGs. This is especially true for fishing vessels homeported in New Bedford, with the SWDA being directly southeast of the port and regularly traversed by the commercial fleet. Fishing vessels not able to travel through or deploy fishing gear within the SWDA would need to travel longer distances to access fishing locations, resulting in increased travel time and trip costs. Additionally, as commercial fishing vessels typically stay out at sea over multiple days, vessels would be navigating at nighttime or during adverse weather conditions.

The applicant’s analysis of the economic exposure of fisheries to Alternative B estimated that average annual dockside value of fish harvested commercially in the SWDA in 2019 dollars is $739,521, and that fishing revenue in areas impacted by cable installation activities in the OECC is approximately $12,000 (COP Appendix III-N; Epsilon 2022a; King and Associates 2021). However, the economic impacts associated with lost fishing revenues would be less than total economic exposure (King and Associates 2021). Potential displacement of fishing vessels and increased competition on fishing grounds unoccupied by structures would have long-term impacts. Space use conflicts could cause a temporary or permanent reduction in fishing activities and fishing revenue, as some displaced fishing vessels may not opt to, or may not be able to, fish in alternative fishing grounds. Commercial fishing vessels have well established and mutually recognized traditional fishing locations. The relocation of fishing activity outside the SWDA or OECC may increase conflict among fishermen as other areas are encroached. Competition is expected to be higher for less mobile species (e.g., lobster, crab, surf clam/ocean quahog, and scallop). Additional Phase 1 structures could lead to fish aggregation of structure-oriented species, increasing the opportunities for for-hire recreational fishery resources. This could contribute to space use conflicts with the commercial fisheries within the SWDA. **Moderate** impacts are expected on commercial fisheries, and **minor** to **moderate** impacts are expected on for-hire recreational fishery resources due to potential displacement and lost revenue.

The presence of structures from Phase 1 operations would increase the risk of highly localized, periodic temporary impacts on fishing activities during construction and would have potentially long-term and **minor** to **moderate** impacts on commercial and for-hire recreational fisheries that use mobile bottom gear.

During decommissioning, removal of structures that produce an artificial reef effect would result in loss of any beneficial fishery impacts that would have occurred during operations but would also eliminate the potential allisions and snag hazards. Therefore, the impacts on commercial and for-hire recreational fisheries resources from Phase 1 decommissioning would be **negligible** to **moderate**, with a **moderate** beneficial impact due to structure removal.

Traffic: Phase 1 construction vessel traffic would increase the risk of collisions due to the presence of Phase 1 vessels. Non-Project vessels navigating around Phase 1 WTGs and ESPs under construction would experience more complex navigation conditions due to the need to avoid structures (allisions), as well as other proposed Project and non-Project vessels also conducting similar maneuvers. Offshore construction of Phase 1 would temporarily restrict access to the OECC route and SWDA during construction. Construction support vessels, including vessels carrying assembled WTGs or WTG components, would be present in the waterways between the SWDA and the ports used during Phase 1 construction. An average of 30 and a maximum of 60 vessels would operate in the OECC and SWDA at any time during Phase 1 construction (COP Volume III, Section 7.8.2; Epsilon 2022a). The applicant’s proposed Maritime Coordinator and vessel traffic management plan (Appendix H) are expected to reduce vessel conflicts. Although fishing vessels may experience increased transit times, such situations would be spatially and temporally limited. Overall, Phase 1 vessel activities in the open waters between the SWDA and ports and along the OECC would have **minor** impacts on fishing vessels.

Impacts of Phase 2

Except for the IPFs described below, the impacts of Phase 2 are expected to be similar to, and marginally larger than, those described for Phase 1 and would have the same impact magnitudes.

If the applicant selects the SCV as part of the final Phase 2 design, some or all of the impacts on commercial fisheries and for-hire recreational fishing from the Phase 2 OECC through Muskeget Channel may not occur, while impacts along the SCV route would occur. In particular, fishing vessels that primarily operate from New Bedford and nearby ports could be more directly impacted than vessels that primarily operate from Cape Cod, Martha’s Vineyard, and Nantucket. Overall, based on available information, BOEM anticipates that the impacts of the SCV on commercial fisheries and for-hire recreational fishing would be similar to those for the Phase 2 OECC through Muskeget Channel, described below. If the SCV is chosen, BOEM will provide a more detailed analysis of the SCV impacts on commercial fisheries and for-hire recreational fishing in a supplemental NEPA analysis.

Phase 1 and Phase 2 would each result in a similar number of vessels performing similar operations, as well as similar construction methods and component infrastructure. Phase 2 would include the potential use of bottom-frame foundations for WTGs and ESPs (COP Volume I, Section 4.2.1; Epsilon 2022a). As shown in Table C-3 in Appendix C, each bottom frame foundation would require up to 1.7 acres of scour protection, compared to 1.2 acres for monopiles and 1.6 acres for each jacket foundation. As a result, the impacts of Phase 2 would be marginally larger than, but substantively similar to, those described for Phase 1. Specifically, Phase 2 would have **negligible** to **minor** impacts for noise; **negligible** to **moderate** impacts for the presence of structures; **minor** to **moderate** impacts from climate change; and **minor** impacts from anchoring and gear utilization, cable emplacement and maintenance, and vessel traffic. Phase 2 construction would have **minor** beneficial impacts on commercial fishery and for-hire recreational fishery resources from the presence of structures.

Phase 2 operations would be similar to (and would likely be combined with) Phase 1 operations and would result in **negligible** to **minor** impacts for noise; **negligible** to **moderate** impacts for the presence of structures; **minor** to **moderate** impacts from climate change; and **minor** impacts from anchoring and gear utilization, cable emplacement and maintenance, and vessel traffic. Phase 2 operations would have **minor** beneficial impacts on commercial fishery and for-hire recreational fishery resources from the presence of structures.

Phase 2 decommissioning impacts would be similar to those described for Phase 1 decommissioning and would range from **negligible** to **moderate,** with a **moderate** beneficial impact due to structure removal. The **negligible** to **moderate** impacts of decommissioning Phase 2 would not increase the impacts beyond that of Alternative A.

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-6 in Appendix G would contribute to impacts on commercial fisheries and for-hire recreational fisheries through the primary IPFs of anchoring and gear utilization, cable emplacement and maintenance, climate change, noise, port utilization, presence of structures, and traffic. Other offshore wind projects would each have land disturbance impacts, but these impacts would be unlikely to occur in the same geographic area or timeframe as Alternative B and are, thus, not considered as cumulative impacts. Cumulative impacts would primarily occur through changes in navigational hazards (e.g., from anchoring and gear utilization, cable emplacement and maintenance, presence of structures); changes to fishing locations; changes to gear type and size able to be used; change in fishery stock (e.g., from noise, presence of structures and scour protection); and increased risk of vessel collisions, allisions, and gear loss.

Up to seven offshore wind projects in the RI/MA Lease Areas (including the proposed Project) could be under construction simultaneously in 2025. The cumulative impacts of all IPFs from ongoing and planned activities, including offshore wind, range from **negligible** to **major** and **minor** beneficial.

Conclusions

Impacts of Alternative B. The impacts of Alternative B on commercial fisheries and for-hire recreational fishing would range from **negligible** to **moderate** and **minor** beneficial**.** Alternative B would contribute to impacts on commercial and for-fire recreational fisheries through all of the IPFs named in Section 3.9.2.1 except for port utilization. Impacts from Alternative B would include temporary and long-term consequences resulting from anchoring and gear utilization, cable emplacement and maintenance, noise, presence of structures, and vessel traffic. Other impacts associated with Alternative B may occur as a consequence of routine activities after the applicant completes construction (i.e., cable maintenance), although the impact of routine post-construction activities on commercial and for-hire recreational fisheries is likely to be **negligible** based on the small portion of area within the SWDA and OECC that would be affected. Impacts from the presence of structures may result in **minor** beneficial impacts on commercial fisheries and for-hire recreational fishing due to fish aggregation. The most prominent IPFs of Alternative B are expected to be presence of structures, noise (specifically from pile driving), and climate change. In general, the impacts are likely to be local and not alter the overall character of commercial and for-hire recreational fisheries resources in the geographic analysis area. Despite fishing location changes, risk to fishing gear and vessels from structures and other vessels, and temporary or permanent habitat alteration, the long-term impact on commercial and for-hire recreational fisheries resources from Alternative B would be **moderate**, as the impacts could be measurable on a site-level scale, but not so within the entire proposed Project area, and the resources would likely recover over time. The applicant may elect to pursue a course of action within the PDE that would cause less impact than the maximum-case scenario evaluated above but doing so would not likely result in different impact ratings than those described above.

Cumulative Impacts of Alternative B. The cumulative impacts on commercial fisheries and for-hire recreational fishing in the geographic analysis area would be **negligible** to **major** and **minor** beneficial. Considering all the IPFs together, the combined impacts from ongoing and planned activities, including Alternative A, would result in **major** impacts on commercial fisheries and for-hire recreation fishing in the geographic analysis area. The impact rating is driven mostly by impacts due to the presence of structures (cable protection measures and foundations), increased risk of vessel and structure strikes and gear loss, changes to available fishing locations, changes to fish distribution/availability due to ongoing climate change, and reduced stock levels due to ongoing fishing pressure.

The applicant is developing and would implement procedures for handling compensation to fishermen for potential gear loss (COP Appendix III-N; Epsilon 2022a). The applicant also plans to contribute to fisheries research and education, including a commitment to provide up to $2.5 million to support fisheries research in partnership with the University of Connecticut and Connecticut Sea Grant. Additionally, as part of Phase 1, the applicant would allocate up to $7.5 million in funds to support environmental initiatives, assist Connecticut fishermen, and further bolster local communities in Connecticut where offshore wind development is taking place (COP Appendix III-N and Volume III, Section 7.6.3; Epsilon 2022a).

BOEM has proposed guidance to lessees for mitigating impacts on commercial and recreational fisheries (https://www.boem.gov/sites/default/files/documents/renewable-energy/DRAFT%20Fisheries%20Mitigation%20Guidance%2006232022_0.pdf). These mitigation measures may change as a result of comments on the guidance document or in response to comments on this Draft EIS. BOEM is evaluating the following mitigation and monitoring measures to address impacts on commercial fisheries and for-hire recreational fishing, as described in detail in Table H-2 of Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

- Implement a gear loss and damage compensation program consistent with BOEM's draft guidance for mitigating impacts on commercial fisheries and for-hire recreational fishing. This measure would address the IPF for presence of structures during construction and operations by reducing impacts resulting from loss of gear associated with uncharted obstructions resulting from the proposed Project.
- Implement a compensation program for lost income from commercial fisheries and for-hire recreational fishing activities and other eligible fishing interests consistent with BOEM draft guidance. This measure would address the IPF for presence of structures by compensating fishing interests for lost income during construction and a minimum of 5 years post-construction.
- Design cable protection measures to reflect the existing conditions at the site and specifically to avoid introducing new hangs for mobile fishing gear by making cable protection measures "trawl-friendly" with tapered/sloped edges. If cable protection is necessary in "non-trawlable" habitat, such as rocky habitat, the applicant would use materials that mirror that benthic environment.

The mitigation and monitoring measures listed above would address the presence of structures IPF by compensating fishing interests by reducing gear loss and compensating for lost income during and after proposed Project construction. These measures, if adopted, would reduce presence of structure impacts from **moderate** to **minor** but would not change the overall **moderate** impact rating for Alternative B.

3.9.2.4 Impacts of Alternative C – Habitat Impact Minimization Alternative on Commercial Fisheries and For-Hire Recreational Fishing

Alternatives C-1 and C-2 would not affect the number or placement of WTGs or ESPs for the proposed Project compared to Alternative B. Alternatives C-1 and C-2 would alter the exact routes of inter-array, inter-link, and export cables installed for the proposed Project and could, thus, affect the exact length of cable installed and area of ocean floor disturbed:

- Alternative C-1 would avoid impacts on complex habitats in the Western Muskeget Variant by removing that route as an option for Phase 2. Under this alternative, all three Phase 2 export cables would be installed in the Eastern Muskeget route, as well as both cables for Phase 1.
- Alternative C-2 would limit the number of export cables installed in the Eastern Muskeget route to three (both Phase 1 cables and one Phase 2 cable) and would include installation of up to two cables in the Western Muskeget Variant. This would reduce impacts on complex habitats in the Eastern Muskeget route.

The Western Muskeget Variant would affect less seafloor acreage than the Eastern Muskeget route; however, the Western Muskeget Variant is only comprised of a complex seafloor, while the Eastern Muskeget route is comprised of a complex seafloor, hard coarse deposits, and soft bottom (Table 3.4-2). Because of the rare habitats provided by complex and hard coarse deposit seafloor types, avoidance of disturbance to these habitats would also result in lower impacts on commercial fisheries and for-hire recreational fishing (additional discussion is provided in Section 3.9.1).

Alternative C-1 would use only the Eastern Muskeget route, which would eliminate impacts on commercial fisheries and for-hire recreational fishing in the Western Muskeget Variant. The Eastern

Muskeget route contains more types of habitat than the Western Muskeget Variant, but less of the habitat is complex seafloor. Using only the Eastern Muskeget route in Alternative C-1 would, therefore, affect more habitat types and a wider variety of commercial fisheries and for-hire recreational fishing species inhabiting or reliant on these habitats than if the Western Muskeget Variant were used. However, Alternative C-1 would affect less of the complex habitat compared to Alternative B (which includes the potential use of the Western Muskeget Variant).

Alternative C-2 could use both the Eastern Muskeget route and the Western Muskeget Variant and would, therefore, affect fish species important to commercial fisheries and for-hire recreational fishing that inhabit or rely on complex seafloor, hard coarse deposits, and soft bottom habitats across a larger area than Alternative C-1. Under Alternative C-2, dredging for Phase 2 cable installation could impact up to 73 acres and could include up to 274,800 cubic yards of dredged material (compared to 67 acres and 235,400 cubic yards for Alternative B and Alternative C-1). The impacts of Alternative C-2 on commercial fisheries and for-hire recreational fishing for species in the Eastern Muskeget route would be less than those under Alternative C-1, and potentially less than those of Alternative B because Alternative C-2 would involve installation of fewer cables in the Eastern Muskeget route. The impacts of Alternative C-2 on commercial fisheries and for-hire recreational fishing for species present in complex habitats would be greater in Alternative C-2 than Alternative C-1, due to the installation of up to two cables in that corridor (where no such cables would be installed under Alternative B or Alternative C-1). Overall, Alternative C-2 would have greater impacts than Alternative C-1 on fish species important to commercial fisheries and for-hire recreational fishing that inhabit or rely on complex seafloor habitats due to impacts within both the Eastern and Western Muskeget.

To the degree that Alternatives C-1 and C-2 reduce impacts on commercially important fish and invertebrate species, they could have marginally lower impacts on commercial fisheries and for-hire recreational fishing than Alternative B. However, these differences in impacts would not result in meaningfully different impacts compared to those of Alternative B. Therefore, the impacts of Alternatives C-1 and C-2 on commercial fisheries and for-hire recreational fishing would be the same as those of Alternative B: **negligible** to **moderate** and **minor** beneficial. In the context of ongoing and planned activities, the cumulative impacts of Alternatives C-1 and C-2 along with ongoing and planned activities would be similar to those of Alternative B: **negligible** to **major** and **minor** beneficial.

3.10 Cultural Resources

3.10.1 Description of the Affected Environment

3.10.1.1 Geographic Analysis Area

This section discusses existing conditions in the geographic analysis area for cultural resources as described in Table D.1 in Appendix D, Geographical Analysis Areas, and shown on Figure 3.10-1. Specifically, this includes terrestrial and offshore areas potentially affected by the proposed Project's land- or bottom-disturbing activities, areas where structures from the proposed Project would be visible, and the area of intervisibility where structures from both the proposed Project and future offshore wind projects would be visible simultaneously. Table G.1-7 in Appendix G, Impact-Producing Factor Tables and Assessment of Resources with Minor (or Lower) Impacts, describes existing conditions and the impacts, based on the IPFs assessed for ongoing and future offshore activities other than offshore wind, which is discussed below.

Cultural resources refer to many heritage-related resources defined in federal laws and EOs, including NEPA and the NHPA. For the purpose of this analysis, cultural resources, which broadly refers to archaeological sites, buildings, structures, objects, and districts, which may include cultural landscapes and traditional cultural properties (TCP), have been divided into three principal types: archaeological resources, historic structures, and TCPs. Archaeological resources comprise areas where human activity has altered the earth and/or deposits of physical remains of past human activity (e.g., artifacts) are found. Historic structures include standing buildings, bridges, dams, and other structures of historic or aesthetic significance. TCPs are places, landscape features, or locations associated with the cultural practices, traditions, beliefs, lifeways, arts, crafts, or social institutions of a living community. These resources may be historic properties as defined in 36 CFR Part 800 (Protection of Historic Properties), which are eligible for or listed in the National Register of Historic Places (NRHP), as well as those resources listed on state or local registers, or may be identified as being important to a particular group during consultation. Federal, state, and local regulations recognize the public's interest in cultural resources. Many of these regulations require a project to consider how it might affect significant cultural resources. Generally, historic properties must be more than 50 years old to warrant consideration for the NRHP. Historic properties less than 50 years old might warrant protection if they are of exceptional importance or have the potential to gain significance in the future.

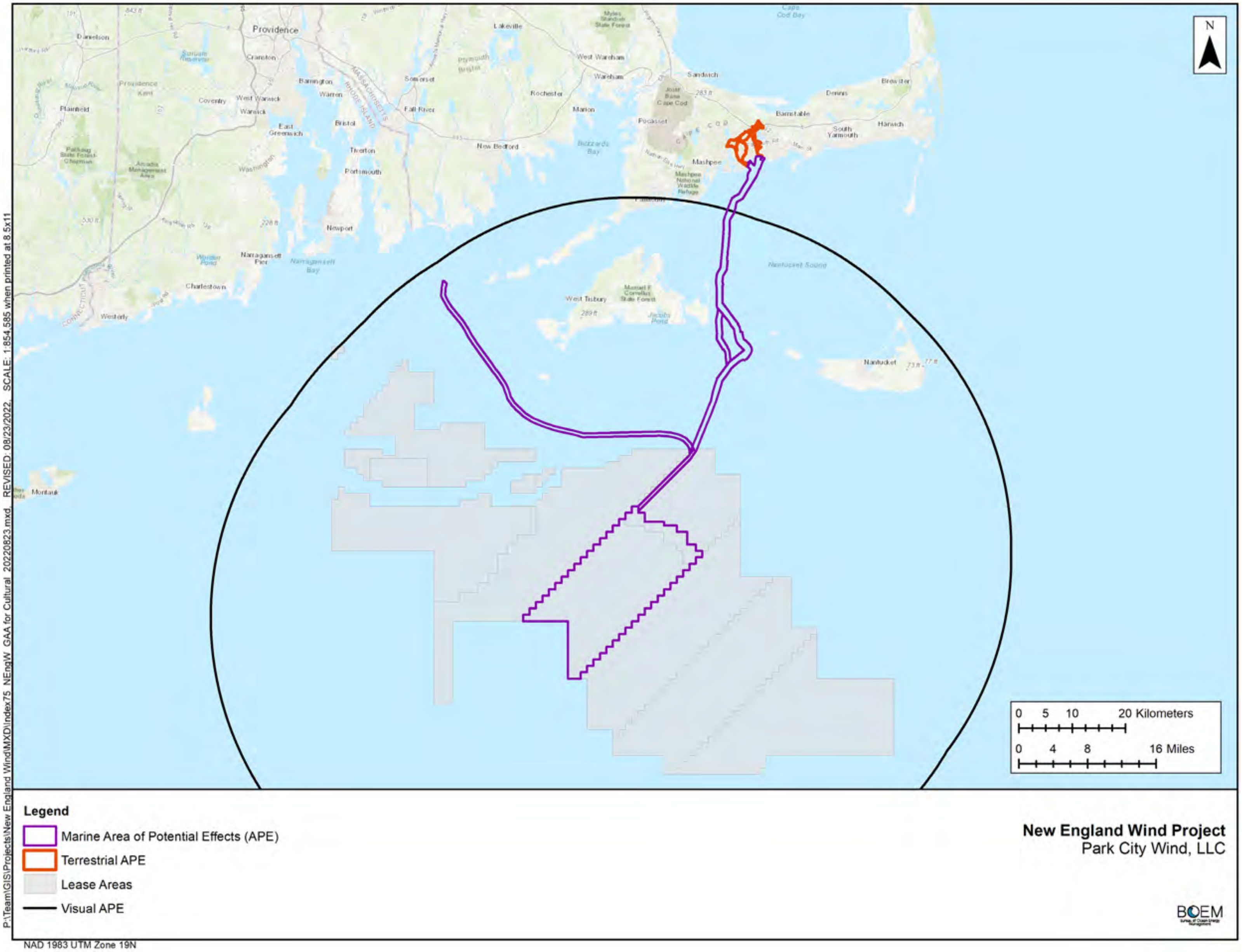


Figure 3.10-1: Geographic Analysis Area for Cultural Resources

The geographic analysis area for cultural resources is equivalent to the proposed Project's area of potential effect (APE), as defined in the implementing regulations for NHPA Section 106 at 36 CFR Part 800. In 36 CFR § 800.16(d), the APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alteration in the character or use of historic properties, if any such properties exist."[20] BOEM (2018c) defines the proposed Project APE as the following:

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

3.10.1.2 Cultural Resources within the Affected Environment

Onshore cultural resource investigations in the northeastern United States have identified a wide variety of archaeological resources, historic structures, and 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 17th through 20th century European -American 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 17th 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 Americans, European-Americans, 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, which likely contain Native American archaeological sites inundated and buried as sea levels rose at the end of the last Ice Age. Marine geophysical remote sensing studies performed for Alternative B identified 16 ancient submerged landform features with the potential to contain Native American archaeological resources within the combined Phase 1 and 2 SWDA (SAL-04 through SAL-19) and 16 ancient submerged landform features (referred to as Channel Groups in the COP) within the OECC; all of the proposed offshore wind lease areas are in areas with high probability for containing these ancient submerged landform features. Ten of the ancient submerged landforms are within Phase 2 and the Phase 1 or Phase 2 boundary area, and six are within Phase 1 (COP Appendix II-D; Epsilon 2022a). In addition to their archaeological potential, Native American tribes in the region consider remnant ancient submerged landscape features to be TCP resources representing places where their ancestors lived. Post-Contact 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 Phase 1 identified three potential shipwrecks (AF-01 through AF-03) within the SWDA, one potential shipwreck (PSW-3) within the OECC, and two potential shipwrecks within the West Muskeget Variant. Based on known

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[20] 36 CFR Part 800 defines effects on historic properties in terms of direct and indirect effects. For the purposes of this analysis, both physical impacts or effects and visual impacts or effects on historic properties are considered direct effects as defined in the NHPA and its implementing regulations (36 CFR Part 800).

historic and modern maritime activity in the region, all of the proposed offshore wind lease areas are in areas with a high probability for containing shipwrecks, downed aircraft, and related debris fields.

A Historic Properties Visual Impact Assessment for Alternative B identified a circa 1956 motel within the onshore APE for direct physical impacts. The boundaries of two historic properties are within the onshore APE for direct physical impacts: the Old King's Highway Regional Historic District (BRN.O) and West Barnstable East Area (BRN.AN). Seven historic properties are located within the onshore APE for direct visual impacts near the Centerville River crossing, if trenchless crossing is not feasible: BRN.2225, 2226, 2227, 2228, and 2229. The Phase 1 offshore APE for direct visual impacts contains 19 historic properties, including the Gay Head Lighthouse, the Edwin Vanderhoop Homestead, the Gay Head – Aquinnah Shops Area, the Vineyard Sound and Moshup's Bridge TCP, the Chappaquiddick Island TCP, the Nantucket Sound TCP, and the Nantucket Historic District National Historic Landmark (NHL). Applicant surveys and studies of the onshore component of Alternative B identified one recorded site (19-BN-253) within the construction area for a trenchless exit pit and pipe laydown and 16 archaeological sites that could be affected by ground-disturbing activities associated with Phase 1 onshore construction, in areas within 0.5 mile of the Phase 1 OECR, grid interconnection route, and substation sites. Applicant surveys and studies of the onshore component of Phase 2 identified 0 NRHP-listed archaeological sites, 42 pre-Contact archaeological sites, and 15 post-Contact archaeological sites that could be affected by ground-disturbing activities associated with Phase 2 construction in areas within 0.5 mile of the Phase 2 OECR, grid interconnection route, and substation sites (COP Appendix III-G; Epsilon 2022a).

Table 3.10-1 presents a summary of the pre-Contact period and post-Contact period cultural context of southern New England.[21]

The applicant has conducted onshore and offshore cultural resource investigations (Table 3.10-2) to identify known and previously undiscovered cultural resources within the marine archaeological, terrestrial archaeological, and viewshed portions of the APE.

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[21] In this context, "Contact" refers to the arrival of Europeans in southern New England circa 1620.

Table 3.10-1: Summary of Southern New England Prehistoric and Historic Context

Period		Description
Pre-Contact Period	Paleoindian (12,500–10,000 B.P.)	Earliest scientifically documented human occupation of southern New England. Small highly nomadic family groups of hunter-gatherers inhabited the region during this period. At this time, much of Nantucket Sound was exposed land due to lower sea levels associated with the last Ice Age and likely occupied by Paleoindian groups.
	Archaic (10,000–3,000 B.P.)	Archaeologists typically divided the Archaic Period into three sub-periods: Early (10,000–8,000 B.P.), Middle (8,000–6,000 B.P.), and Late (6,000–3,000 B.P.) Archaic. During the Early Archaic, the population of southern New England continued to practice a highly mobile, nomadic hunter-gatherer lifestyle adapted to the warming conditions and changing environment. By the Late Archaic, populations developed a more locally focused subsistence economy and a semi-sedentary lifestyle.
	Woodland (3,000–400 B.P.)	Archaeologists typically divided the Woodland Period into three sub-periods: Early (3,000–2,000 B.P.), Middle (2,000–1,000 B.P.), and Late (1,000–400 B.P.) Woodland. The Woodland Period is marked by the appearance of the first ceramic vessel technology in southern New England. The population of southern New England became increasingly sedentary throughout the Woodland Period. By the end of the Late Woodland Period, populations lived in settled, agricultural villages.
Post-Contact Period	European Exploration (A.D. 1000–1620)	This period began with the arrival of European explorers and anglers in New England during the 16th century. John Smith explored the southern New England coastline in 1614–1615 and Puritan colonists established the Plymouth Colony in 1620.
	European Settlement (A.D. 1620–1720)	During the 17th and early 18th centuries, both trade and conflict grew between Native American groups and European colonists. Europeans colonized Martha's Vineyard in 1641–1642 with the establishment of Edgartown. Thomas Macy and family colonized Nantucket in the winter of 1659–1660. The earliest records of shore-based whaling on Nantucket by European colonists date to this period. European colonists founded the towns of Barnstable and Yarmouth during this period in the late 17th century.
	European Colonialism and Early Nationalism (A.D. 1720–1815)	During the 18th and early 19th centuries, trade between Europe and New England increased, leading to the growth of commercial cities along the southern New England coast. Colonization of interior New England progressed throughout the period, leading to the removal, forced migration, and/or extermination of Native American populations. European colonial powers fought numerous wars in North America during the 18th century, culminating in the Seven Years' War between England, France, and their respective colonies. Near the end of the period, the American Revolution (1775–1783) ended English colonial rule in southern New England and led to the founding of the United States of America. After the war, the maritime economy of southern New England, including fishing and whaling, continued to grow. Near the end of the period, the United States and England fought a second war, the War of 1812 (1812–1814), which significantly affected the maritime economy of southern New England. As the 19th century began, industrial mill towns began to appear throughout New England.
	Early Industrialization (A.D. 1815–1865)	The 19th century was a period of population growth and rapid industrialization across New England, as well as the growth of shipbuilding, fishing, trade, and whaling industries. The 19th century was also the "Golden Age" of southern New England whaling industry on Nantucket and coastal cities such as New Bedford and New London. During the United States Civil War (1861–1865), thousands of men from southern New England fought in campaigns across the southern United States of America.
	Late 19th Century–Early 20th Century (A.D. 1865–1950s)	The late 19th and early 20th centuries saw a marked decline in the merchant marine and whaling industries across southern New England. In addition, American westward expansion and the rise of Midwest industrial centers also contributed to a general decline in the population of New England. The tourism industry on Martha's Vineyard, Nantucket, Cape Cod, and across southern New England, including the recreational fishing industry and maritime tourism, expanded rapidly during the early and mid-20th century.

Source: COP Appendix III-G; Epsilon 2022a

B.P. = before present; A.D. = Anno Domini

Table 3.10-2: Summary of Cultural Resources Investigations and Cultural Resources for the Proposed Project

Project Area/APE	Studies[a]	Summary of Findings
Offshore	Marine Archaeological Assessment Report for the New England Wind Offshore Wind Farm for OCS-A 0534 Construction and Operations Plan (COP Volume II-D; Epsilon 2022a)	• The applicant's cultural resources consultant conducted a MARA of HRG survey data collected by multiple non-intrusive survey campaigns by third-party marine survey contractors within the SWDA. • Three potential shipwrecks were identified within the SWDA, which are recommended for avoidance. • 16 ancient submerged landform features were identified within the SWDA, avoidance is recommended to the extent feasible.
Offshore	Marine Archaeological Assessment Report for the OECC (COP Volume II-D, Appendix A; Epsilon 2022a)	• The applicant's cultural resources consultant conducted a MARA for the proposed OECC, as well as support for HRG surveys and geotechnical activities for the OECC. • Survey activities were conducted over five seasons from 2016 to 2020 (extending to February 2021). • One potential shipwreck was identified within the SWDA, which is recommended for avoidance. • 16 ancient submerged landform features, identified as Channel Groups 8-18, 21-22, 29, and 30 are considered to belong to the Nantucket Sound TCP; avoidance is recommended to the extent feasible.
Offshore	Marine Archaeological Assessment Report in Support of the South Coast Variant Offshore Export Cable Corridor Construction and Operations Plan (COP Volume II-D, Appendix E; Epsilon 2022a)	• The applicant's cultural resources consultant conducted a marine archaeological resources assessment of the proposed SCV of the OECC, as well as to provide archaeological support for high-resolution geophysical marine surveys and subsequent geotechnical activities for the OECC. • Two potential shipwrecks were identified within the SCV OECC, which are recommended for avoidance. • Seventeen ancient, submerged landform features were identified within the SCV OECC. Avoidance is recommended to the extent feasible.
Onshore	Terrestrial Archaeology Reports: Phase 1 Report: Archaeological Reconnaissance Survey, Vineyard Wind 501 South Phase 1 Onshore Development Area, Potential Export Cable Routes and Proposed Substation (COP Appendix III-G; Epsilon 2022a)	• The Phase 1 Reconnaissance Report survey was conducted for the potential export cable routes and proposed substation project in the Town of Barnstable. • The study area consisted of the preliminary area of potential effects and a 0.5-mile buffer. • Archival research identified 16 archaeological sites, including 8 pre-Contact sites, 7 post-Contact site, and 1 site multicomponent within and/or adjacent to the study area. • Zones of high archaeological sensitivity were identified in the proposed landfall sites at Covell's and Craigville beaches and the southern end of the OECR in Barnstable. • Small zones of high sensitivity for pre-Contact sites are at the southern end of Long Pond and north shore of Wequaquet Lake. • Zones of high and moderate sensitivity within the north portion of the APE are the substation at 8 Shootflying Hill Road, a section of existing utility ROW, and west of Wequaquet Lake. • Zones of high sensitivity for post-Contact archaeological resources exist along the export cabling routes near an NRHP-listed property along Phinneys Lane. • Zones of moderate sensitivity for pre- and post-Contact resources are within the potential export cabling routes along the Eversource ROW; Shootflying Hill; Great Marsh and Old Stage Roads; Main, South Main, and Oak Streets; and Phinneys Lane. • Archaeological monitoring of construction activities was recommended within the identified zones of high and moderate archaeological sensitivity along existing roads in the proposed Project area. The consultant also recommended an intensive archaeological survey for the proposed substation at the 8 Shootflying Hill Road and Parcel #214-001.

Project Area/APE	Studies[a]	Summary of Findings
Onshore	Terrestrial Archaeology Report - Phase 1 Report: Intensive Archaeological Survey New England Wind Phase 1 (Park City Wind)/New England Wind 1 Connector Onshore Project Components (COP Appendix III-G; Epsilon 2022a)	• The Phase 1 Intensive Archaeological Survey was conducted in the locations of four proposed onshore components in the Town of Barnstable. • The four onshore proposed Project components are 6.7-acre and 1.00-acre parcels for a substation site at 6 and 8 Shootflying Hill Road, a trenchless crossing entry bore and a 1,960-square-foot temporary work zone for an onshore export cable crossing of the Centerville River within a 0.28-acre residential lot at 2 Short Beach Road, a trenchless exit pit and 400-foot long pipe laydown north of the Centerville River in the shoulder of Craigville Beach Road, and a 2.8-acre parcel (Parcel 214-001) for proposed trenchless crossing under Route 6. • Two pre-Contact find spots and a site were identified and recommended not eligible for NRHP listing. • No additional archaeological investigations are recommended. Archaeological monitoring of other components within areas of moderate or high archaeological sensitivity will be conducted during construction.
Onshore	Technical Memorandum, Vineyard Wind 501 South Phase 2 Onshore Export Cable Routing and Substation Envelope, Cultural Resources Archaeological Due Diligence Study, June 1, 2020; Revised March 26, 2021 (COP Appendix III-G; Epsilon 2022a)	• Due diligence study of the Phase 2 onshore export cable route and substation envelope was conducted. Portions overlap with Phase 1 potential cable routes. • No NRHP-listed archaeological sites are within the study area. • 42 pre-Contact and 15 post-Contact sites have been identified within the study area. • The recorded pre-Contact sites can be considered to form four broad groups or clusters within different physiographic settings in the Phase 2 study area. They are the Centerville Harbor; Cotuit/West Bay and North Bay; Santuit River; and the Race Lane and Wequaquet Lake clusters. • The post-Contact sites are within the Cotuit/West Bay and North Bay, Marstons Mills, Race Lane and Prospect Street, Wequaquet Lake and Garretts Pond (north of Route 6) sections of Barnstable. • Based on the results of the due diligence review and the drive-over of the study area, the Phase 2 Onshore Export Cable Routing and Substation Envelope contains areas of moderate to high archaeological sensitivity.
Onshore	Archaeological Reconnaissance Survey New England Wind Phase 2 (Commonwealth Wind)/New England Wind 2 Connector (COP Appendix III-G; Epsilon 2022a)	• The Phase 1 Reconnaissance Report survey was conducted for the Phase 2 connector, onshore export cable routes to identify known pre-Contact, Contact, and post-Contact cultural resources within 0.5-mile study area and the APE. • The proposed Project area consisted of two alternate cable landfall sites at Dowses Beach and Wianno Avenue and potential onshore export cable routes along existing roadways and utility ROWs in Barnstable. • Research identified no NRHP-listed archaeological site. Fifteen recorded pre-Contact and 13 post-Contact archaeological sites were identified within the onshore export cable route study area. • Of the research-identified sites, four pre-Contact, five post-Contact and one site with pre-Contact, Contact, and post-Contact components may be located within and/or adjacent to the Phase 2 onshore export cabling route options. • A combined windshield/walkover survey was conducted to further refine zones of archaeological sensitivity initially delineated in a due diligence study for the Phase 2 potential onshore export cable routes. • Archaeological monitoring of proposed Project construction areas within the staging areas required for HDD in the landfall area and during installation of onshore export cable and other components within the identified zones of high and moderate archaeological sensitivity are recommended.

Project Area/APE	Studies[a]	Summary of Findings
Onshore	Technical Memorandum, New England Phase 2 Potential Onshore Substation Sites, Cultural Resources Archaeological Due Diligence Study, April 20. 2022 (COP Appendix III-G; Epsilon 2022a)	• Due diligence study of the Phase 2 OECR and substation envelope was conducted. Portions overlap with Phase 1 potential cable routes. • No NRHP-listed archaeological sites are within the study area. • Forty-two pre-Contact and 15 post-Contact sites have been identified within the study area. • The recorded pre-Contact sites can be considered to form four broad groups or clusters within different physiographic settings in the Phase 2 study area: Centerville Harbor, Cotuit/West Bay and North Bay, Santuit River, and the Race Lane and Wequaquet Lake clusters. • The post-Contact sites are within the Cotuit/West Bay and North Bay, Marstons Mills, Race Lane and Prospect Street, Wequaquet Lake, and Garretts Pond (north of Route 6) sections of Barnstable. • Based on the results of the due diligence review and the reconnaissance of the study area, the Phase 2 onshore export cable routing and substation envelope contains areas of moderate to high archaeological sensitivity.
Viewshed	New England Wind Visual Impact Assessment (COP Appendix III-H.a; Epsilon 2022a)	• The applicant's consultants conducted a visual impact assessment to identify potential visibility of Alternative B's offshore facilities and determine the difference in landscape quality with and without the proposed Project in place.
Viewshed	New England Wind Historic Properties Visual Impact Assessment (COP Appendix III-H.b; Epsilon 2022a)	• The Historic Properties Visual Impact Assessment identified a variety of historic properties that the proposed Project may affect. These include an NHL, properties listed on the NRHP, TCPs, properties on the Massachusetts State Register of Historic Places, and properties on the Inventory of Historic and Archaeological Assets of the Commonwealth. • It was determined that the proposed Project would have a visual impact on the Gay Head Lighthouse, the Edwin Vanderhoop Homestead, the Gay Head – Aquinnah Shops Area, the Chappaquiddick Island TCP, and Vineyard Sound and the Moshup's Bridge TCP.

APE = area of potential effect; COP = Construction and Operations Plan; HDD = horizontal directional drilling; HRG = high-resolution geophysical; MARA = marine archaeological resources assessment; NHL = National Historic Landmark; NRHP = National Register of Historic Places; OECC = offshore export cable corridor; OECR = onshore export cable route; TCP = traditional cultural property; ROW = right-of-way; SCV = South Coast Variant; SWDA = Southern Wind Development Area

[a] Not all reports are publicly available due to sensitive information.

3.10.2 Environmental Consequences

Definitions of impact levels for cultural resources are described in Table 3.10-3.

Table 3.10-3: Impact Level Definitions for Cultural Resources

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable (i.e., finding of "no historic properties affected" or "no historic properties adversely affected" pursuant to 36 CFR Part 800).
	Beneficial	Impacts that benefit cultural resources would be so small as to be unmeasurable.
Minor	Adverse	Cultural resources (historic properties that include archaeological sites, building, structures, objects and districts that are listed or eligible for listing in the NRHP) would be affected; however, conditions would be imposed to ensure consistency with the Secretary of the Interior's Standards for the Treatment of Historic Properties (36 CFR Part 68) to avoid adverse impacts (i.e., finding of "no historic properties adversely affected" pursuant to 36 CFR Part 800).
	Beneficial	Impacts that benefit cultural resources (historic properties that include archaeological sites, building, structures, objects, and districts that are listed or eligible for listing in the NRHP) would passively preserve historic properties consistent with the Secretary of the Interior's Standards for the Treatment of Historic Properties or passively create conditions to protect archaeological sites.

Impact Level	Impact Type	Definition
Moderate	Adverse	Characteristics of cultural resources would be altered in a way that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association (i.e., finding of "historic properties adversely affected" pursuant to 36 CFR Part 800). Measures to resolve adverse effects would minimize impacts, and the adversely affected property would remain NRHP eligible.
	Beneficial	Impacts that benefit cultural resources would actively preserve historic properties (historic properties that include archaeological sites, building, structures, objects, and districts that are listed or eligible for listing in the NRHP) consistent with the Secretary of the Interior's Standards for the Treatment of Historic Properties.
Major	Adverse	Characteristics of cultural resources would be altered in a way that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association (i.e., finding of "historic properties adversely affected" pursuant to 36 CFR Part 800). Measures to resolve adverse effects would mitigate impacts; however, important characteristics would be altered to the extent that the adversely affected property would no longer be listed or eligible for listing in the NRHP.
	Beneficial	Impacts that benefit cultural properties would rehabilitate, restore, or reconstruct historic properties consistent with the Secretary of the Interior's Standards for the Treatment of Historic Properties, including cultural landscapes and TCPs.

CFR = Code of Federal Regulations; NRHP = National Register of Historic Places; TCP = traditional cultural property

3.10.2.1 Impacts of Alternative A – No Action Alternative on Cultural Resources

When analyzing the impacts of Alternative A on cultural resources, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the existing conditions for cultural resources (Table G.1-7 in Appendix G). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for cultural resources described in Section 3.10.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Each of the ongoing offshore wind activities has been subject to NEPA and NHPA reviews, and BOEM assumes that each planned offshore wind project would also be subject to the same reviews. These reviews require the identification of cultural resources within their NEPA geographic analysis areas and NHPA APEs.[22] The results of some project-specific studies to identify cultural resources impacted by planned offshore wind projects are not yet available. Therefore, Alternative A assumes that the same types of cultural resources identified within the geographic analysis area of the proposed Project (i.e., historic structures, terrestrial archaeological sites, marine archaeological sites, and TCPs) are present within the geographic scopes of the planned offshore wind projects and will be subject to the same IPFs as the proposed Project. The following discussion assesses the potential impacts on these types of cultural resources from proposed wind facility developments, excluding the proposed Project. BOEM assumes that if project-specific cultural resource investigations identify historic properties within a project's APE and determines that the project would 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.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on cultural resources include ongoing construction of Vineyard Wind 1 in OCS-A 0501 and the South Fork Wind

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[22] The NEPA geographic analysis area for each offshore project includes areas impacted by planned offshore wind projects, whereas the NHPA APE for each project is limited to the areas within which each project may affect historic properties.

Project in OCS-A 0517. Ongoing construction of the Vineyard Wind 1 and South Fork Wind projects, along with planned offshore wind activities, would affect cultural resources through the primary IPFs described below.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than Alternative B). Future offshore wind activities would affect cultural resources through the following primary IPFs.

Accidental releases: Accidental release of hazardous materials and trash/debris, if any, may result in long-term, infrequent impacts on cultural resources. The majority of impacts associated with accidental releases would be incidental due to cleanup activities that require the removal of contaminated soils. There would be a low risk of a leak of fuel, fluids, or hazardous materials from any of the approximately 1,044 WTGs and ESPs. In total, approximately 5.3 million gallons of these materials 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. As described in Section G.2.1, Air Quality, 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 transported by ongoing activities (U.S. Energy Information Administration 2014). The number of accidental releases from Alternative A, 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.

Although the majority of anticipated accidental releases would be small, resulting in small-scale impacts on cultural resources, a single, large-scale accidental release such as an oil spill could have significant impacts. A large-scale release would require extensive cleanup activities to remove contaminated materials resulting in damage to, or 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 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 and gear utilization: Anchoring associated with ongoing commercial and recreational activities and the development of future offshore wind projects has the potential to cause permanent impacts on marine cultural resources. Anchoring would increase during the construction, maintenance, and eventual decommissioning of future offshore wind energy facilities. The placement and relocation of anchors and other seafloor gear such as wire ropes, cables, and anchor chains that impact or sweep the seafloor could potentially disturb shipwreck and debris field resources on or just below the seafloor surface. The damage or destruction of submerged archaeological sites or other underwater cultural resources from these activities would result in the permanent and irreversible loss of scientific or cultural value.

Ongoing and planned offshore wind activities are likely to include monitoring surveys in the offshore wind lease areas. These could include acoustic, trawl, and trap surveys, as well as other methods of sampling the biota in the area. The presence of monitoring gear could affect cultural resources through seafloor disturbance; however, it is expected that monitoring plans would have sufficient mitigation procedures in place to reduce potential impacts. These procedures are expected to include, but not be limited to, avoidance of shipwrecks and debris fields. Monitoring surveys are unlikely to involve activities that penetrate the seafloor deep enough to affect ancient submerged landforms. Impacts from gear utilization from other offshore wind activities on benthic resources are likely to occur at short-term, regular intervals over the lifetime of the projects and have no perceptible consequences for cultural resources.

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. The potential for impacts would be mitigated, however, by existing federal and state requirements to identify and avoid marine cultural resources. Specifically, as part of its compliance with the NHPA (including NHPA Section 106 requirements fulfilled through the NEPA substitution process, as described in 36 CFR § 800.8[c]), BOEM requires offshore wind developers to conduct geophysical remote sensing surveys of proposed development areas to identify cultural resources and implement plans to avoid, minimize, and/or mitigate impacts on these resources. As a result, impacts on marine cultural resources from anchoring 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 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.

Cable emplacement and maintenance: Construction of future offshore wind infrastructure would have permanent, geographically extensive impacts on cultural resources. Future offshore wind projects would result in the construction of 913 WTGs and ESPs (excluding the proposed Project), as well as seabed disturbance from installation of associated offshore export, inter-array, and inter-link cables. Impacts from these WTG and ESP foundations, as well all associated inter-array and inter-link cables under Alternative A, would be outside of the marine archaeological resources APE. Impacts from associated offshore export cables would also be outside of the marine archaeological resources APE, except for approximately 69 acres of impact from the Vineyard Wind 1 OECC (which would be collocated with the proposed Project) and an unknown acreage where the Mayflower Wind OECC would cross the proposed Project OECC. Crossings of other OECCs with the proposed Project OECC are possible but have not been identified.

The effects of dredging activities on marine cultural resources would be similar to the effects of anchoring and could damage or destroy submerged archaeological sites or other underwater cultural resources, resulting in the permanent and irreversible loss of scientific or cultural value. The potential for impacts would be mitigated, however, by existing federal and state requirements to identify and avoid marine cultural resources, similar to those discussed in the IPF for anchoring and gear utilization. As a result, impacts on marine cultural resources from 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 impacts.

As part of compliance with the NHPA, BOEM and state historic preservation offices will require future offshore wind project applicants to conduct extensive geophysical surveys of the SWDA and OECC areas to identify shipwreck and debris field resources, and avoid, minimize, and/or mitigate these resources when identified. Due to these federal and state requirements, the impacts of offshore construction on shipwreck and debris field resources would be infrequent and isolated.

The entire RI/MA Lease Areas cover areas with high probability for containing ancient submerged cultural resources (TRC 2012). In the event an unanticipated discovery is made, the unanticipated discovery plan would be implemented. Formerly sub-aerially exposed and now ancient submerged landscapes that date to a time of Native American inhabitation 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 submerged landform features to be part of a larger cultural landscape occupied by their ancestors. As a result, the ancient submerged landform features are considered part of one or more TCPs 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 ancient submerged landform features make avoidance impossible in many situations and makes extensive archaeological investigations of formerly terrestrial archaeological sites within these features logistically challenging and prohibitively expensive. As a result, offshore construction would result in geographically widespread and permanent impacts on portions of these resources. For those ancient submerged landform features contributing elements to a National Register-eligible TCP, but which cannot be avoided, mitigations will likely be considered under the NHPA Section 106 review process, including studies to document the nature of the paleo environment during the time these now ancient submerged landscapes were occupied, and provide Native American tribes with the opportunity to include their history in these studies.

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 historic structures as erosion undermines their foundations. Ocean acidification could accelerate the rate of decomposition/corrosion of shipwreck, downed aircraft, and other marine archaeological resources on the seafloor. The 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.

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

Lighting: Development of future offshore wind projects 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 aircraft and vessel hazard/warning lighting on WTGs and ESPs during operation. Up to 903 WTGs and 10 ESPs (other than those for the proposed Project) would be added within the geographic analysis area for cultural resources.

Construction and decommissioning lighting would be most noticeable if construction activities occur at night. As shown in Table E-1 in Appendix E, up to nine offshore wind projects could be constructed in the APE from 2022 through 2030, with up to six projects simultaneously under construction in 2025 (excluding the proposed Project). Some of the 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/MA Lease Areas. Aircraft and vessel hazard lighting systems would be in use for the entire operations stage of each future offshore wind project, resulting in long-term 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 and historic properties on the southern shores and inland-elevated locations of Martha's Vineyard and Nantucket, including the Gay Head Lighthouse, the Edwin Vanderhoop Homestead, the Gay Head – Aquinnah Shops Area, Nantucket NHL, Vineyard Sound and Moshup's Bridge TCP, the Chappaquiddick Island TCP, and the Nantucket Sound TCP, for which a dark nighttime sky is a contributing element to historical integrity. While some resources such as historic buildings and lighthouses would be closed to stakeholders at night, and some resources, such as historic districts, generate their own nighttime light, the dark nighttime sky is still a contributing element to these cultural resources. The intensity of lighting impacts would be limited by the distance between resources and the nearest lighting sources, as the majority of the proposed WTGs are located over 15 miles from the nearest shoreline (Section 3.16, Scenic and Visual Resources). 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 impacts on a limited number of cultural resources. Operational lighting would have longer-term, continuous, and localized impacts on a limited number of cultural resources.

Permanent aviation hazard and vessel navigation lighting would be required on all WTGs and ESPs built by ongoing and planned offshore wind projects. Aviation hazard lighting on WTGs consisting of red lights on the nacelle flashing 30 times per minute, as well as mid-tower red lights flashing at the same frequency. Of the 903 WTGs constructed in the geographic analysis area for cultural resources, 692 would have nacelle-top aviation warning lights that could potentially be visible from onshore historic properties (Section 3.16). BOEM assumes that FAA hazard lighting for all offshore wind projects in the RI/MA Lease Areas would use ADLS. ADLS would activate the aviation lighting on WTGs and ESPs only when an aircraft is within a predefined distance of the structures (Section 3.16). For the proposed Project, this is estimated to occur during less than 0.1 percent of total annual nighttime hours (COP Appendix III.H-b; Epsilon 2022a). The use of ADLS lighting on future offshore wind projects other than the proposed Project would likely result in similar limits on the frequency of WTG and ESPs aviation warning lighting use. This technology, if used, would reduce the already low-level impacts of lighting on cultural resources.

Port utilization: Future offshore wind activity could lead to port expansion and increased port utilization in Massachusetts, Rhode Island, Connecticut, New York, and other states along the U.S. East Coast (Section G.2.7, Land Use and Coastal Infrastructure). Offshore wind developers have made commitments to upgrade or expand port infrastructure and utilization in some locations. For example, Ørsted 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 necessary to carry WTG and ESP 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 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.

Presence of structures: Based on marine archaeology assessments conducted for the proposed Project (COP Appendix II-D; Epsilon 2022a) and other ongoing and planned offshore wind projects in the RI/MA Lease Areas, BOEM assumes that planned offshore wind projects in the geographic analysis area would also affect ancient submerged landform features unless these features could be avoided. None of the foundations, inter-link cables, or inter-array cables from other offshore wind projects would be within the marine archaeological APE. Nearly all OECCs for other offshore wind projects would also be outside of the marine archaeological APE, except for the Vineyard Wind 1 OECC (which would be collocated with the proposed Project) and the Mayflower Wind OECC (which would cross the proposed Project OECC). Any damage to ancient submerged landform features in these limited areas of cumulative impact would threaten the viability of the affected portion of these resources.

The development of 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. Onshore development associated with future offshore wind projects, including substations and possibly transmission lines, would also introduce new, modern, and intrusive visual elements to the viewsheds of cultural resources along the transmission routes and near the new onshore substations.

Under Alternative A, onshore visual impacts on cultural resources from the presence of structures would be limited to those cultural resources from which any aboveground component, (i.e., substations and transmission lines) would be visible, which may include both standing structures and archaeological sites for which landscape or setting are contributing elements to NRHP eligibility. The magnitude of impacts from the presence of structures would be greatest for cultural resources for which a view, free of modern visual elements, is an integral part of their historic integrity and contributes to their eligibility for listing on the NRHP. Visibility of structures would be affected by distance and environmental conditions such as vegetation. Additional mitigation, such as vegetative buffering, could reduce the visibility of onshore structures and reduce the magnitude of visual impacts on cultural resources.

Under Alternative A, offshore visual 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. Portions of approximately 903 WTGs (excluding the proposed Project) could be visible from onshore cultural resources for which an uninterrupted sea view, free of intrusive visual elements, is a contributing element to NRHP eligibility. The magnitude of impacts from the presence of structures would be greatest for cultural resources for which a maritime view, free of modern visual elements, is an integral part of their historic integrity and contributes to their eligibility for listing on the NRHP. Due to the distance between planned offshore wind development and the nearest cultural resources, in most instances exceeding 15 miles, 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 visual impacts on cultural resources.

Conclusions

Impacts of Alternative A. Under Alternative A, the proposed Project would not be built. However, cultural resources would continue to be affected by regional commercial, industrial, and recreational activities including approved offshore wind projects. While the proposed Project would not be built under Alternative A, ongoing activities would have continuing short- and long-term impacts on cultural resources. The primary source of onshore impacts from ongoing activities include ground-disturbing activities and the introduction of intrusive visual elements, while the primary source of offshore impacts includes dredging, cable emplacement and maintenance, and activities that disturb the seafloor. These ongoing activities would have **minor** to **major** impacts on individual onshore and offshore cultural resources.

Cumulative Impacts of Alternative A. In addition to ongoing activities, planned activities could include the same type of onshore and offshore actions listed for ongoing activities, and in different locations than ongoing activities. These planned activities would also have **minor** to **major** impacts on individual onshore and offshore cultural resources depending on the scale and extent of impacts and the unique characteristics of the resource. Examples of individual resources are paleolandforms, terrestrial archaeological sites, historic standing structures, and TCPs. Impacts vary widely because the impacts are dependent on the unique characteristics of the individual resources. The combination of ongoing and planned activities would result in **minor** to **major** impacts on individual cultural resources depending on the scale and extent of impacts and the unique characteristics of the resources. Impacts vary widely because the impacts are dependent on the unique characteristic of the individual resource.

The construction, operations, and decommissioning of planned offshore wind projects would have **minor** to **major** impacts, as well as **negligible** to **minor** beneficial impacts on individual offshore cultural resources. The construction of onshore components and port expansion, as well as their operation, would have **negligible** to **minor** impacts on individual cultural resources.

Considering all the IPFs together, both adverse and beneficial, as well as state and federal requirements to avoid, minimize, or mitigate impacts on cultural resources, the overall impacts of ongoing and planned activities in the geographic analysis area would result in **moderate** impacts on cultural resources.

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

While impacts on cultural resources could range from **minor** to **major**, implementation of existing state and federal cultural resource laws and regulations would reduce the magnitude of overall impacts on cultural resources due to requirements to avoid, minimize, or mitigate Project-specific impacts on cultural resources. These state and federal requirements may not be able to reduce the severity of impacts on some cultural resources due to the unique character of specific resources but would reduce the severity of potential impacts in a majority of cases.

3.10.2.2 Relevant Design Parameters and Potential Variances in Impacts

The following proposed Project design parameters (Appendix C, Project Design Envelope and Maximum-Case Scenario) would influence the magnitude of the impacts on cultural resources:

- Physical impacts on terrestrial cultural resources (e.g., archaeological sites) would depend on the location of onshore ground-disturbing activities.
- Physical impacts on marine cultural resources (e.g., archaeological sites and ancient submerged landscapes) would depend on the location of offshore bottom-disturbing activities. This includes the locations where the applicant would embed the WTG and ESP towers into the seafloor in the SWDA and the location of the cable in the OECC.
- Visual impacts on cultural resources (e.g., historic architectural structures, landscapes, and TCPs) would depend on the design, height, number, and distance of WTGs visible from these resources.

Potential impacts on cultural resources include damage or destruction of terrestrial archaeological sites or TCPs from onshore ground-disturbing activities and damage to or destruction of submerged archaeological sites or other underwater cultural resources (e.g., shipwreck, debris fields, and ancient submerged landforms) from offshore bottom-disturbing activities, resulting in a loss of scientific and/or cultural value. Potential impacts from the construction of onshore export cable routes, grid interconnection routes, and the onshore substation also include demolition of, damage to, or alteration of historic structures or districts, resulting in a loss of historic and/or cultural value. Potential visual impacts also include introduction of visual elements out of character with the setting or feeling of historic structures, landscapes, and TCPs, if that setting is a contributing element to the resource's eligibility for listing on the NRHP. The most impactful IPFs would include lighting, the presence of structures, anchoring and gear utilization, land disturbance, and cable emplacement and maintenance.

3.10.2.3 Impacts of Alternative B – Proposed Action on Cultural Resources

This section identifies potential impacts of Alternative B on cultural resources.

Impacts of Phase 1

Phase 1 would affect cultural resources through the following primary IPFs during construction, operations, and decommissioning. Except where specifically discussed, the impacts of decommissioning would be similar to the impacts from construction and would be eliminated entirely as decommissioning is completed.

Accidental releases: Accidental release of hazardous materials and trash/debris, if any, could affect cultural resources. Section G.2.2, Water Quality, describes the types and volumes of hazardous materials in Phase 1 WTGs and ESPs, along with the likelihood of a release. Phase 1 is predicted to have up to 36,440 gallons of fuels and oils stored in each WTG and 124,098 gallons of fuels and oils per ESP, for a total of approximately 1.5 million gallons of these materials, about 45 percent of the total for both phases of the proposed Project (COP Table 3.3-6, Volume I; Epsilon 2022a). In the event of an accidental release, the volume of materials released is unlikely to require cleanup operations that would permanently impact cultural resources. As a result, the impacts of accidental releases from Phase 1 on cultural resources would be short term, localized, and **negligible**.

Impacts from accidental release of hazardous materials, trash, or debris would have the same intensity and extent during Phase 1 operations as during construction. As a result, impacts on cultural resources under this IPF from Phase 1 operations would be **negligible**.

Anchoring and gear utilization: Phase 1 construction, operations, and decommissioning may require anchoring within the geographic analysis area that could potentially affect cultural resources. The applicant conducted HRG surveys and marine archaeological resource assessment of the SWDA and OECC over five survey seasons in 2016, 2017, 2018, 2019, and 2020 (COP Appendix II-D; Epsilon 2022a). Field investigations during all five surveys included a marine HRG survey using magnetometer, side-scan sonar, sub-bottom profiler, and multibeam echosounder. Geotechnical explorations included bottom grabs, cone penetration tests, bores, and/or vibracores conducted in the SWDA and along the OECC. These data assisted in validating the geophysical data and interpretations and provided material for additional archaeological analysis (COP Appendix II-D; Epsilon 2022a). The HRG and geotechnical surveys identified one shipwreck in the Phase 1 OECC, none within the Phase 1 SWDA. The applicant has committed to avoiding these resources where possible during construction activities. Due to these commitments, BOEM does not anticipate impacts on known shipwrecks from Phase 1 anchoring. SAL-04 and SAL-05 would be avoided (COP Appendix II-D; Epsilon 2022a), and SAL-014 through SA-019 in the Phase 1 SWDA and the 16 ancient submerged landforms in the OECC may not be avoidable during construction activities. As a result, the Phase 1 anchoring would have long-term, localized, and **negligible** to **major** impacts depending on the physical effects on these resources. Larger impacts could occur if a submerged ancient landform is affected by anchors or if a previously undiscovered resource is affected (COP Volume I, Table 3.3.3; Epsilon 2022a).

As described in Section 3.10.2.1, survey gear could affect cultural resources through seafloor disturbance. BOEM assumes surveys would be required to avoid shipwrecks and debris fields, and sampling activities would not penetrate the seafloor to a depth sufficient to disturb ancient submerged landforms. Therefore, the impacts of gear utilization associated with Phase 1 on cultural resources would have no perceptible consequences for cultural resources. Operational vessel traffic would be lower than during construction (Section 3.13, Navigation and Vessel Traffic); therefore, anchoring from Phase 1 operations would have **negligible** impacts on marine cultural resources. Anchoring during Phase 1 decommissioning would have the same impacts as during construction: long term, localized, and **negligible** to **major**.

Cable emplacement and maintenance: The expected installation method for Phase 1 offshore cables is jet plow embedment or jet trenching limited dredging for installing the offshore export cable and an inter-array cable system. As previously stated, remote sensing studies for the proposed Project identified 1 shipwreck and 21 landform features (stream channel, lake, and estuarine landscape features) within the SWDA and OECC (COP Appendix III-G; Epsilon 2022a). While applicant studies did not find any direct evidence of pre-Contact Native American cultural materials, regional Native American tribes consider the ancient submerged landforms culturally significant TCPs as portions of a landscape occupied by their ancestors.

Disturbance and destruction of even a portion of potential shipwrecks or identified ancient submerged landform features could threaten the scientific and/or cultural viability of these resources in their entirety as both potential repositories of scientific and archaeological knowledge, as well as their cultural significance to tribes. For shipwrecks, the severity of impacts would depend on the horizontal and vertical extent of the proposed disturbance relative to both the size of the cultural resource, but also relative to the nature of the information that may be lost from future archaeological and scientific understanding within that discrete portion of the resource. The applicant has voluntarily committed to avoiding the shipwreck and debris fields, by a recommended 164 feet, and would not affect these resources. BOEM determined that Phase 1 would have long-term, localized, and **negligible** impacts on shipwreck and debris field cultural resources.

For ancient submerged landform features that cannot be avoided by Phase 1 construction, additional required mitigations to resolve impacts would be determined by ongoing Section 106 consultation. Implementation of a treatment plan agreed to by all parties would likely reduce the magnitude of impacts on ancient submerged landform features; however, the magnitude of these impacts would remain **major** due to the permanent, irreversible nature of the potential impacts.

Cables emplaced during construction would continue to affect cultural resources, especially ancient submerged landform features. Additional ground-disturbing activities associated with maintenance could result in additional disturbance and destruction of potential shipwrecks or identified ancient submerged landform features, which could threaten the scientific and/or cultural viability of these resources in their entirety as both potential repositories of scientific and archaeological knowledge, as well as their cultural significance to tribes. Operations of Phase 1 would have long-term, localized, and **negligible** impacts on shipwreck and debris field cultural resources.

For unavoidable ancient submerged landform features, additional mitigation to resolve impacts would be required, as determined by ongoing Section 106 consultation. Implementation of a treatment plan agreed to by all parties would reduce the impact magnitude on ancient submerged landform features; however, the magnitude of these impacts would remain **major** due to the permanent, irreversible nature of the impacts.

Phase 1 decommissioning would have the same impacts as construction: long term, localized, and **negligible** to **major**.

Climate change: Construction of Phase 1 would generate impacts on air quality (Section G.2.1). Therefore, Phase 1 construction would have a short-term and **negligible** impact on cultural resources.

Operations of Phase 1 would marginally reduce or displace emissions from conventional power generation, thereby contributing to slowing or arresting global warming and associated climate change and having a long-term and **negligible** to **minor** beneficial impact on cultural resources.

Land disturbance: Applicant surveys and studies of the onshore component of Phase 1 (COP Appendix III-G; Epsilon 2022a) identified one recorded site (19-BN-253) within the construction area for a trenchless exit pit and pipe laydown and 16 archaeological sites that could be affected by ground-disturbing activities associated with Phase 1 onshore construction (Phase 1 landfall site, export cables, onshore substation site, and connection from the proposed substation site to the existing bulk power grid), in areas within 0.5 mile of the Phase 1 OECR, grid interconnection route, and substation sites (COP Appendix III-G; Epsilon 2022a). These surveys identified zones of high sensitivity for pre-Contact archaeological sites at the southern end of Long Pond and northern shore of Wequaquet Lake. Zones of high and moderate sensitivity for pre-Contact archaeological sites are in the proposed substation at 8 Shootflying Hill Road (Parcel 124-001) and sections of existing utility ROW in proximity to the Shootflying Hill Site (19-BN-699, BRN.HA.17) and west of Wequaquet Lake. A zone of high sensitivity for post-Contact archaeological resources exists along the OECR adjacent to the Ancient Burying Ground (BRN.807), a NRHP-listed property on Phinney's Lane, and the Old Town House (BRN.HA.56), a property for which eligibility for listing in the NRHP is undetermined (COP Appendix III-G; Epsilon 2022a). Zones of moderate sensitivity for pre -and post-Contact archaeological resources are within the OECR along the Eversource ROW; at Shootflying Hill; at Great Marsh and Old State Roads; at Main, South Main, and Oak Streets; and at Phinneys Lane. Based on these findings, the applicant has recommended archaeological monitoring of Phase 1 onshore construction activities within the staging areas required for the HDD in the selected landfall area and during installation of the OECR and other components within the identified zones of high and moderate sensitivity. The Massachusetts Historical Commission (MHC) concurrence with this recommendation is pending.

An intensive-level archaeological survey was conducted in the locations of four proposed onshore components: the substation sites at 6 and 8 Shootflying Hill Road, the entire 2.8-acre Parcel 214-001, and a trenchless crossing entry bore and temporary work zone of the Centerville River within a residential lot at 2 Short Beach Road. Pre-Contact Native American material was identified during this survey. These finds and site were recommended not eligible for listing on the NRHP, and no additional investigations would be warranted. MHC concurrence with this recommendation is pending. The applicant completed terrestrial archaeological investigations aligned with Massachusetts state requirements in all portions of the terrestrial archaeological APE.

The applicant's onshore cultural resource investigations determined that Phase 1 would not impact any known terrestrial cultural resources. The applicant has committed to conducting archaeological monitoring during construction in areas previously determined to have a moderate to high potential for undiscovered archaeological resources and would employ the unanticipated discovery plan in the event of such a discovery. Based on the results of the terrestrial archaeological investigations and considering the possible presence of undiscovered resources, onshore construction of Phase 1 would have localized, long-term, and **minor** to **moderate** impacts on terrestrial cultural resources.

BOEM is evaluating the following mitigation and monitoring measures to address impacts on cultural resources, as described in detail in Table H-2 of Appendix H, Mitigation and Monitoring. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval):

- Require the applicant to avoid any identified archaeological resource or TCP; or, if the applicant cannot avoid the resource, it must perform additional investigations to determine eligibility for listing in the NRHP. Of those resources determined eligible, BOEM would require Phase III data recovery investigations for the purposes of resolving adverse effects per 36 CFR § 800.6. Avoidance would result in **negligible** direct impacts whereas data recovery investigations for resources that cannot be avoided and would otherwise be damaged or destroyed would result in **major** impacts on terrestrial archaeological resources.
- Require archaeological monitoring during onshore construction in areas identified as having high or moderate archaeological sensitivity and implementation of a terrestrial post-review discoveries plan would reduce potential impacts on any previously undiscovered archaeological resources (if present) encountered during construction. Archaeological monitoring and the implementation of a post-review discoveries plan would reduce potential impacts on undiscovered archaeological resources to **negligible** by preventing further physical impacts on the archaeological resources encountered during construction.

A Historic Properties Visual Impact Assessment for both phases of Alternative B identified a circa 1956 motel within the onshore APE for direct physical impacts; the applicant recommended this property as not eligible for listing on the NRHP (COP Appendix III.H-b; Epsilon 2022a). The boundaries of two historic properties are within the onshore APE for both direct physical impacts and direct visual impacts: the Old King’s Highway Regional Historic District (BRN.O) and West Barnstable East Area (BRN.AN). Based on the results of the onshore visual impact investigations, and considering the possible presence of unidentified resources, onshore construction of Phase 1 would have localized, long-term, and **minor** to **moderate** impacts on aboveground cultural resources.

The Phase 1 onshore substation site, OECR, and splice vaults would require minimal maintenance, typically completed by accessing the cables through utility access holes or within the fenced perimeter of the substation. If the selected OECR follows existing utility ROWs rather than roads, trees along those portions of the OECR would be removed (as needed) and would not be allowed to regrow. As a result, Phase 1 operations would have **negligible** impacts on cultural resources. Excavation for repairs would be rare and could impact undiscovered archaeological sites. Federal (i.e., NEPA and NHPA Section 106) and state requirements to identify cultural resources, assess impacts, and implement measures to avoid, minimize, and/or mitigate impacts, including the unanticipated discovery plan, would minimize impacts on cultural resources if these circumstances arose in future development.

Removal of Phase 1 onshore cables during decommissioning, if required, would be accomplished without land disturbance or excavation. If the substation, or other aboveground components, were to be removed, the impacts would be similar to those experienced during construction. As a result, Phase 1 decommissioning would result in localized, long-term, and **minor** impacts on terrestrial cultural resources.

Lighting: The susceptibility and sensitivity of cultural resources to lighting impacts from Phase 1 would vary based on the unique characteristics of individual cultural resources. Nighttime lighting impacts would be restricted to cultural resources for which a dark nighttime sky is a contributing element to their historic integrity, cultural resources stakeholders use at night, and resources that do not generate a substantial amount of their own light pollution. Examples of these types of resources in the geographic analysis area of this study include the Chappaquiddick Island TCP, Vineyard Sound and Moshup’s Bridge TCP, and the Nantucket Sound TCP.

Phase 1 construction may require nighttime vessel and construction area lighting. Impacts of this lighting on cultural resources would be short term, occurring only during Phase 1 construction, and 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. On Martha's Vineyard and Nantucket, the nearest WTGs and ESPs from cultural resources on the islands range from 21.2 to 28.6 miles. The intensity of nighttime construction lighting impacts would also decrease significantly during the construction of WTGs and ESPs farther from shore as distance between the lighting source and resources increases. 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 Phase 1 would have short-term, low intensity effects on Gay Head Lighthouse, the Edwin Vanderhoop Homestead, the Gay Head – Aquinnah Shops Area, Chappaquiddick Island TCP, Vineyard Sound and Moshup's Bridge TCP, the Nantucket Sound TCP, and the Nantucket Historic District, resulting in **minor** impacts on cultural resources.

Phase 1 operations would include aviation hazard lighting on top of WTG nacelles and navigation warning lights for vessels on WTGs and ESPs. Aviation warning lights would use ADLS to reduce operations stage nighttime lighting impacts. ADLS would only activate the required FAA aviation obstruction lights on WTGs and ESPs when aircraft enter a predefined airspace and turn off when the aircraft are no longer in proximity to the SWDA (COP Appendix III-K; Epsilon 2022a). More specifically, in accordance with FAA Advisory Circular 70/7460-1M (FAA 2020), lights controlled by an ADLS must be activated and illuminated prior to an aircraft reaching 3 nautical miles (3.5 miles) from within 1,000 vertical feet of any WTG. Due to the speed of the traveling aircraft and size of the SWDA, the resulting appearance of the lights would be limited to a few minutes in each instance. ADLS activation for Phase 1 would occur for less than 9 minutes per year (less than 0.1 percent of annual nighttime hours) (COP Appendix III-K; Epsilon 2022a). As a result, the use of ADLS for Phase 1 would result in intermittent, low intensity (rather than continuous), and **minor** impacts on the nine cultural resources located near Martha's Vineyard and Nantucket, in the APE for direct visual effects offshore.

USCG navigation warning lights would be mounted near the top of the foundation on each WTG and ESP. The lighting is relatively low intensity and is designed to be visible up to at least 5 nautical miles (5.8 miles) (COP Appendix III-H.a; Epsilon 2022a). This lighting could be visible to mariners at sea but would not be visible from coastal vantage points because the closest land location, the shoreline of Martha's Vineyard, to the nearest WTG or ESP would be over 21 miles away.

Phase 1 decommissioning would have the same intensity/extent of impacts as those during construction. As a result, nighttime lighting associated with decommissioning the infrastructure of Phase 1 would have long-term, low intensity impacts on a limited number of resources, resulting in **minor** impacts on cultural resources.

Port utilization: Phase 1 construction would use the Port of Bridgeport, and could also use numerous other ports in Massachusetts, Rhode Island, Connecticut, and beyond (Section G.2.7). As stated in Section 3.10.1.1, some of these ports have been or would be expanded to accommodate the offshore wind industry, although the applicant has not funded or otherwise prompted any specific expansions. 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 any port expansions. As a result, Phase 1 construction would have **negligible** impacts on cultural resources under this IPF.

Operations and decommissioning of Phase 1 would have the same intensity and extent of impacts on cultural resources as construction. Therefore, Phase 1 would have **negligible** impacts on cultural resources under this IPF.

Presence of structures: A Historic Properties Visual Impact Assessment for Alternative B identified the boundaries of two historic properties that are within the onshore APE for both direct physical impacts and direct visual impacts: the Old King's Highway Regional Historic District (BRN.O) and West Barnstable East Area (BRN.AN). Seven historic properties are located within the onshore APE for direct visual impacts, near the Centerville River crossing, if trenchless crossing is not feasible, and a utility bridge must be constructed: BRN.2225, 2226, 2227, 2228, and 2229. The applicant determined that both phases of Alternative B would have no effect on the historic properties identified within the onshore APE for direct physical impacts or visual impacts. Heavy vegetation in the area would obscure visibility of the potential utility bridge from these properties, and the Centerville River Bridge, a modern 2002 construction, is already part of the viewshed. Thus, adding another small bridge and fence would not alter the viewshed significantly. MHC concurrence with this finding is pending.

Applicant surveys concluded that Phase 1 would be unable to avoid, and would thus have physical impacts on, 21 ancient submerged landform features in the marine APE due to design constraints (i.e., the submerged landform crosses the entire OECC), engineering, and/or environmental constraints (COP Appendix II-D; Epsilon 2022a). Physical impacts on these resources would threaten the viability of the affected portion of these resources as both potential repositories of archaeological information, as well as the cultural significance of these landforms to local Native American tribes. The severity of impacts would depend on the horizontal and vertical extent of impacts relative to the size of the intact ancient submerged relict landform. Due to the limited size of the offshore remote sensing survey areas in the OECC and SWDA, the full extent or size of individual ancient landforms cannot be defined. The applicant's efforts to identify potential submerged archaeological sites are described in the COP (Appendix II-D; Epsilon 2022a). In the event of an unanticipated discovery, the applicant would notify BOEM and implement the Unanticipated Development Plan. The applicant would notify BOEM within 24 hours of the discovery and provide written notification within 72 hours of the discovery. No action would occur that could affect the potential resource until BOEM conducts an evaluation and instructs the applicant on how to proceed. Based on available information, Phase 1 construction would result in the physical damage or destruction of all or part of the 21 ancient submerged landforms that cannot be avoided. To mitigate impacts, the applicant has proposed conducting additional archaeological investigations in the SWDA and OECC including vibracore analysis. The results of the geotechnical archaeological studies would be shared with the tribes and other stakeholders in a variety of formats as necessary (COP Volume II-D; Epsilon 2022a). As a result, the presence of structures from Phase 1 would have **major** impacts on ancient submerged landform features.

The applicant has voluntarily committed to avoiding the shipwrecks and debris fields, by a recommended 164 feet, and would not affect these resources. As a result, the presence of structures from Phase 1 would have **negligible** impacts on the potential shipwreck in the OECC.

The Phase 1 offshore APE for direct visual impacts includes 19 historic properties, and BOEM determined that the construction of WTGs would affect 7 historic properties: the Gay Head Lighthouse, the Edwin Vanderhoop Homestead, the Gay Head – Aquinnah Shops Area, the Vineyard Sound and Moshup's Bridge TCP, the Chappaquiddick Island TCP, the Nantucket Sound TCP, and the Nantucket Historic District NHL. The visual impact during construction would consist of vessel traffic within the SWDA and possible use of jack-up barges with mobile cranes and other larger construction vessels (COP Appendix III-H.a; Epsilon 2022a). Partially built WTGs and ESPs may also be visible. The limited geographic extent of impacts, the intensity of visual impacts on these historic properties would be limited by distance, environmental, and atmospheric factors. As discussed in Section 3.16, the visibility of WTGs and ESP(s) would be further reduced by environmental and atmospheric factors such as cloud cover, haze, sea spray, vegetation, and wave height. While these factors would limit the intensity of impacts, construction of Phase 1 would have short-term and **minor** impacts on the seven historic properties listed above.

As described above, the applicant determined that the presence of structures in Phase 1 would have **minor** impacts on the historic properties identified within the onshore APE for direct physical effects and direct visual effects. MHC concurrence with this finding is pending. The APE for direct visual effects is the viewshed from which renewable energy structures, whether located offshore or onshore, would be visible for Phase 1 and was determined to be a maximum distance of 37.5 miles from the Phase 1 WTGs.

The cultural resources within the APE for direct visual impacts during Phase 1 operations are the same as those described for this IPF during Phase 1 construction. These include 19 historic properties in the offshore visual APE, of which 7 would be affected: the Gay Head Lighthouse, the Edwin Vanderhoop Homestead, the Gay Head – Aquinnah Shops Area, the Vineyard Sound and Moshup's Bridge TCP, Chappaquiddick Island TCP, Nantucket Sound TCP, and the Nantucket Historic District. BOEM determined that an uninterrupted sea view, free of modern visual elements, is a contributing element to the NRHP eligibility of the seven historic properties. In addition, Phase 1 would only affect southern views from these resources, primarily in coastal and elevated locations (COP Appendix III-H.b; Epsilon 2022a). When viewed broadside, a Phase 1 WTG at the distance of 21.2 miles (the closest Phase 1 WTG to any of the resources listed above) would occupy 0.16 degree horizontally on the horizon and 0.33 degree vertically to the nacelle top. This is the approximate equivalent of a pencil viewed 113 feet away (COP Appendix III-H.a; Epsilon 2022a). The maximum width of the 26-foot blade would measure 0.013 degree horizontally, about the equivalent to the width of a drinking straw viewed 91 feet away (COP Appendix III-H.b; Epsilon 2022a). As a result, the presence of visible WTGs from Phase 1 would have long-term, continuous, widespread, and **moderate** impacts on these resources. 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 at various times throughout the year.

To further minimize and mitigate effects of Phase 1, the applicant has voluntarily committed to the following mitigation and monitoring measures:

- Fund a mitigation plan to resolve impacts on the Gay Head Lighthouse pursuant to NHPA Section 106; and
- Fund a mitigation plan to resolve impacts on the Vineyard Sound and Moshup's Bridge TCP pursuant to NHPA Section 106.

The final minimization and mitigation of impacts would be determined through completion of BOEM's NHPA Section 106 review process and included as conditions of COP approval.

Phase 1 decommissioning would have similar impacts as construction. As structures are removed, visual impacts on cultural resources would disappear.

Impacts of Phase 2

The impacts of Phase 2 on cultural resources would be marginally more extensive than, but would have similar impact magnitudes as, those described for Phase 1 for IPFs related to accidental releases, anchoring and gear utilization, climate change, port utilization, and traffic. The impacts of Phase 2 associated with the IPF for lighting would be less intense than, but would have similar magnitude to, Phase 1, due to the increased distance between onshore viewers and Phase 2 WTGs. While Phase 2 would involve more WTGs and ESPs, a greater length of inter-array cables, and a different OECR in Barnstable, the incremental differences in activity between Phase 2 and Phase 1, as well as the combined effect of

Phase 1 and Phase 2 together, would not change any of the impact magnitudes described for Phase 1 construction, except for the IPFs discussed below.

If the applicant includes the SCV as part of the final proposed Project design, some or all of the impacts on cultural resources from the Phase 2 OECC through Muskeget Channel would not occur. BOEM would provide a more detailed analysis of the impacts of the SCV and the Phase 2 OECC on cultural resources in a supplemental NEPA analysis, if the SCV is selected. The operations and decommissioning within the geographic area of analysis during Phase 2 (with or without the SCV) would have similar impacts as Phase 1 for all IPFs, except as discussed below.

Anchoring and gear utilization: The SCV diverges from the OECC at the northern boundary of Lease Area OCS-A 0501 and travels west-to-northwest to the state waters boundary near Buzzards Bay. The portion of the SCV in federal waters would disturb approximately 307 acres of seafloor (Epsilon 2022a). The seafloor impact within state waters in Buzzard’s Bay has not been determined and would be evaluated as part of a supplemental NEPA analysis. The applicant’s geophysical surveys and marine archaeological resources assessment (MARA) of the OECC for the SCV (Epsilon 2022a), identified 17 ancient submerged landform features and 2 possible shipwreck sites. The applicant anticipates both possible shipwrecks would be avoided. Current proposed Project designs may not be able to avoid the ancient submerged landform features. As a result, Phase 2 would have **negligible** to **major** impacts on marine cultural resources.

Cable emplacement and maintenance: The impacts of SCV cable emplacement on cultural resources would be similar to the impacts of Phase 1, although the number of identified ancient submerged landform features would increase from 16 to 17. The magnitude of these impacts would remain **major**, due to the permanent, irreversible nature of the impacts.

Climate change: The impacts of Phase 2 and SCV construction on climate change would be similar to those for Phase 1: a short-term and **negligible** impact on cultural resources.

Land disturbance: Applicant surveys and studies of the onshore component of Phase 2 (COP Appendix III-G; Epsilon 2022a) identified no NRHP-listed archaeological sites, 42 pre-Contact archaeological sites, and 15 post-Contact archaeological sites that could be affected by ground-disturbing activities associated with Phase 2 construction in areas within 0.5 mile of the Phase 2 OECR, grid interconnection route, and substation sites (COP Appendix III-G; Epsilon 2022a). Portions of the area potentially affected by Phase 2 overlap with the Phase 1 potential cable routes. Based on these findings, the applicant has determined that Phase 2 would not impact any known terrestrial cultural resources. The applicant recommends archaeological monitoring of proposed Project construction activities within the staging areas required for the HDD in the selected Phase 2 landfall area and during installation of the Phase 2 OECR. MHC concurrence with these findings and recommendations is pending. Based on the results of the terrestrial archaeological investigations and considering the possible presence of undiscovered resources and the associated unanticipated discovery plan, onshore construction of Phase 2 would have localized, long-term, and **minor** to **moderate** impacts on terrestrial cultural resources.

BOEM could reduce potential impacts of Phase 2 onshore construction by requiring one or both of the mitigation and monitoring measures described for Phase 1 construction as a condition of COP approval (Appendix H).

Lighting: The impacts of Phase 2 offshore construction on lighting for the SCV would involve similar impacts as Phase 2, but in additional locations, and would be short term, localized, and **minor.**

Presence of structures: Applicant surveys concluded that Phase 2 construction within the SWDA would be unable to avoid 8 ancient submerged landform features and 3 potential shipwrecks and would, therefore, have physical impacts on these 11 features (COP Appendix II-D; Epsilon 2022a). The Phase 2 construction impacts on these features would be similar to those described for Phase 1. As a result, Phase 2 construction under this IPF would have **major** impacts on ancient submerged landform features. As with Phase 1, every reasonable effort has been made to identify potential submerged archaeological sites; however, in the event of an unanticipated discovery, the applicant would notify BOEM and implement the Unanticipated Development Plan. To mitigate impacts, the applicant has proposed conducting additional archaeological investigations in the SWDA, including vibracore analysis. The results of the geotechnical archaeological studies would be shared with the tribes and other stakeholders in a variety of formats as necessary (COP Volume II-D; Epsilon 2022a). The impacts from the presence of structures during Phase 2 construction on cultural resources in the APE for direct visual impacts would be similar to, but less intense than, Phase 1 because Phase 2 WTG and ESP locations would be farther from cultural resources in the APE for direct visual impacts, 37.5 miles, than Phase 1 structures, 35.7 miles. As a result, Phase 2 construction would have short-term and **minor** impacts on the seven historic properties for which an uninterrupted sea view, free of intrusive visual elements, is a contributing element to NRHP eligibility.

The SCV would require approximately 41 acres of hard protection in federal waters. Otherwise, the impacts of SCV construction would be similar to those described for Phase 2: short term, localized, and **minor** to **major.**

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-7 in Appendix G would contribute to impacts on cultural resources through the primary IPFs of anchoring and gear utilization, cable maintenance and emplacement, lighting, and the presence of structures. These impacts would primarily occur through impacts on seven historic properties for which an uninterrupted sea view, free of intrusive visual elements, is a contributing element to NRHP eligibility, as well as impacts on cultural practices and values of Native American tribes resulting from views of WTGs, and damage to submerged ancient landforms.

Other offshore wind projects in the RI/MA Lease Areas would have limited areas of overlap with the proposed Project, primarily limited to shared portions of the proposed Project OECC. Nonetheless, construction of other offshore wind projects that cannot avoid ancient submerged landform features in the marine archaeological APE would result in long-term, widespread, unmitigated, and **major** impacts on ancient submerged landform 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 ancient submerged landform features that cannot be avoided by future offshore wind development projects. Development and implementation of proposed Project-specific treatment plans, agreed to by all consulting parties, would reduce the magnitude of unmitigated impacts on ancient submerged landform features; however, these impacts would remain permanent and irreversible.

The cumulative impacts on cultural resources would range from **negligible** to **major**, with the largest impacts occurring due to the permanent and irreversible impacts on ancient submerged landform features.

Conclusions

Impacts of Alternative B. Alternative B would have **negligible** to **major** impacts on cultural resources. Impacts would be reduced through the avoidance, minimization, and mitigation of identified cultural resources and mitigation and monitoring measures (Appendix H) that BOEM includes as conditions of

COP approval. The impacts analysis is based on a maximum-case scenario; impacts would be reduced by implementation of a less impactful construction or infrastructure development scenario within the PDE (Appendix C). However, neither of these impact reductions would result in different impact ratings than those described above, given the fact that the damage to ancient submerged landform features is irreversible, even with mitigation.

Higher impacts, ranging from **moderate** to **major**, would occur without the pre-construction identification of cultural resources to assess potential impacts, and development of treatment plans to resolve effects through avoidance, minimization, and/or mitigation. These efforts to identify cultural resources and address impacts resulted in or contributed to the applicant making commitments to reduce the magnitude of impacts on cultural resources, including, but not limited to, the use of ADLS hazard lighting (if approved), the use of non-reflective pure white and light grey paint on offshore structures, and the development of treatment plans with consulting parties to address impacts on cultural resources (Appendix H). Requirements to identify historic properties and resolve impacts would similarly reduce the significance of potential impacts on cultural resources from future offshore wind projects as they complete the review process. Thus, the overall impacts on cultural resources from Alternative B would qualify as **moderate** because a notable and measurable impact is anticipated.

Cumulative Impacts of Alternative B. The cumulative impacts on cultural resources in the geographic analysis area would be **negligible** to **major**. This reflects the permanent and irreversible impacts on ancient submerged landforms. It also reflects long-term impacts on seven historic properties for which an uninterrupted sea view, free of intrusive visual elements, is a contributing element to NRHP eligibility: the Gay Head Lighthouse, the Edwin Vanderhoop Homestead, the Gay Head – Aquinnah Shops Area, Vineyard Sound and Moshup's Bridge TCP, Chappaquiddick Island TCP, the Nantucket Sound TCP, and the Nantucket Historic District.

3.10.2.4 Impacts of Alternative C – Habitat Impact Minimization Alternative on Cultural Resources

Alternatives C-1 and C-2 would not affect the number or placement of WTGs or ESPs for the proposed Project, compared to Alternative B. Alternatives C-1 and C-2 would alter the exact routes of inter-array, inter-link, and export cables installed for the proposed Project, and could, thus, affect the exact length of cable installed and area of ocean floor disturbed. To the degree that Alternatives C-1 and C-2 reduce impacts on ancient submerged landforms, they could have marginally different impacts on cultural resources than Alternative B. However, these differences in impacts would not change the magnitude of impact. Therefore, the impacts of Alternatives C-1 and C-2 on cultural resources would be the same as those of Alternative B.

3.11 Demographics, Employment, and Economics

3.11.1 Description of the Affected Environment

3.11.1.1 Geographic Analysis Area

This section discusses demographic, employment, and economic conditions in the geographic analysis area described in Table D-1 in Appendix D, Geographical Analysis Areas, and shown on Figure 3.11-1. 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 SWDA: Barnstable, Bristol, Dukes, Nantucket, and Essex counties, Massachusetts; Providence and Washington counties, Rhode Island; Fairfield and New London counties, Connecticut; Kings, Richmond, Rensselaer, Albany, and Suffolk counties, New York; and Gloucester County, New Jersey. Statewide data for Massachusetts and Rhode Island are provided for reference. Table 3.11-1 describes existing conditions and the impacts of ongoing and future offshore activities other than offshore wind on demographics, employment, and economics based on the IPFs assessed.

Proposed Project facilities and associated port activities would be located primarily within coastal Massachusetts and Rhode Island. Other states that would host proposed Project-related activities include Connecticut, New York, and New Jersey. Tables 3.11-1 through 3.11-35 provide detailed demographic information for the study area. Due to the COVID-19 pandemic, the U.S. Census Bureau has not released 2020 and 2021 demographic, employment, and economic data.

3.11.1.2 Massachusetts

Barnstable, Dukes, and Nantucket Counties, Massachusetts

Barnstable, Dukes, and Nantucket counties are notable for the importance of coastal recreation and tourism to their economies and their high proportion of seasonal housing. Nantucket has the lowest overall population of these counties, as well as the lowest unemployment rate (Table 3.11-1). Barnstable County has the highest total population and population density of the three counties.

Table 3.11-1: Demographic Data (Massachusetts), 2019

Jurisdiction	Population (2019)	Population Density (persons per square mile)[a]	Per Capita Income (2019)	Total Employed (2019)	Unemployment Rate (2019)
Massachusetts	6,850,553	648.4	$43,761	1,780,625	4.8%
Barnstable County	213,496	542.3	$44,505	52,558	4.1%
Bristol County	561,037	1,014.4	$35,747	141,991	5.4%
Dukes County	17,312	167.7	$45,990	4,291	3.4%
Nantucket County	11,168	248.3	$55,398	2,996	2.9%
Essex County	789,034	1,601.9	$33,828	366,590	6.8%

Source: U.S. Census Bureau 2020a

[a] Population density is based on the 2019 population estimates divided by the square miles of each county (World Media Group 2022).

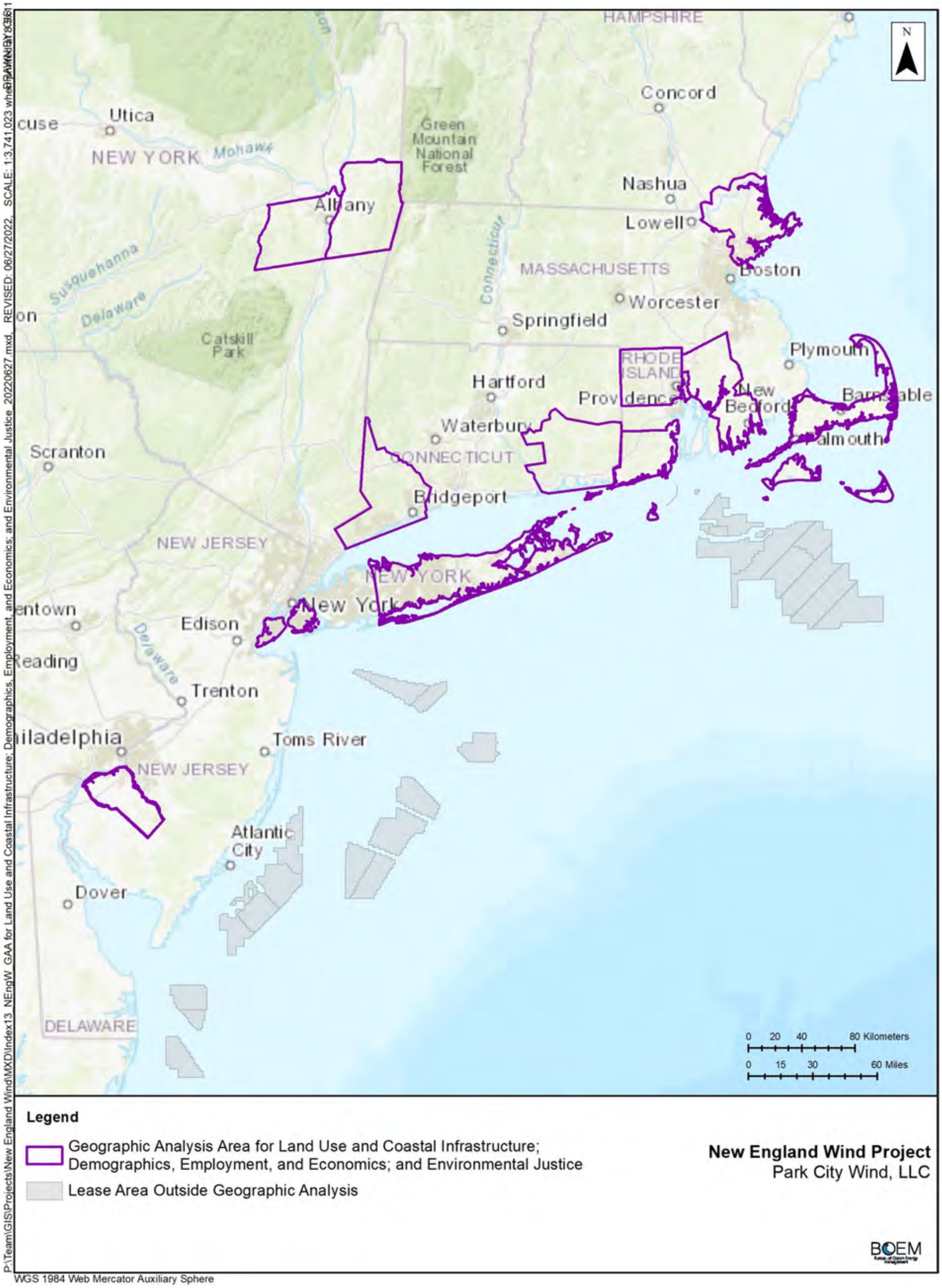

Figure 3.11-1: Geographic Analysis Area for Demographics, Employment, and Economics

The population of Barnstable County declined from 2010 to 2019, while the population of Dukes and Nantucket counties grew (Table 3.11-2). Dukes and Nantucket counties have the smallest population of any counties in Massachusetts (U.S. Census Bureau 2020a). The population of Barnstable and Dukes counties are older, on average, than the population of surrounding counties and Massachusetts as a whole, while Nantucket County's age distribution is similar to the statewide profile (U.S. Census Bureau 2020a). The population in Nantucket County is slightly older than the state average (U.S. Census Bureau 2020a).

Table 3.11-2: Demographic Trends (Massachusetts), 2000–2019

	Population				2019 Population by Age			
Jurisdiction	**2000**	**2010**	**2019**	**Change 2000-2019**	**Under Age 18 (%)**	**Age 18-64 (%)**	**Age 65 or Older (%)**	**Median Age**
Massachusetts	6,349,105	6,547,629	6,850,553	8.6%	20.0%	55.0%	16.2%	39.5
Barnstable County	222,230	215,888	213,496	4.2%	15.3%	62.6%	29.8%	53.3
Bristol County	534,678	548,285	561,037	5.7%	20.8%	58.2%	16.6%	41.0
Dukes County	14,987	16,535	17,312	15.6%	18.5%	64.7%	23.3%	47.1
Nantucket County	9,520	10,172	11,168	19.7%	20.7%	55.0%	14.6%	40.3
Essex County	723,419	744,644	789,034	9%	21.1%	61%	17.6%	40.6

Source: U.S. Census Bureau 2020b

In Massachusetts as a whole, approximately 4 percent of housing units are seasonally occupied, compared to 38 percent of homes in Barnstable County, 60 percent of homes Dukes County, and 62 percent of homes in Nantucket County (Table 3.11-3). Towns in Barnstable County experience significant seasonal population change due to tourism. During the peak tourist season from June through August, the population of Cape Cod grows by "an equivalent [of] 68,856 full-time residents," (COP Volume III, Section 7.1.1; Epsilon 2022a), equivalent to approximately 32 percent of Barnstable County's 2019 population. In addition, "seasonal population continues to grow even as the number of Cape Cod's year-round residents decreased" (COP Volume III, Section 7.1.1; Epsilon 2022a).

Table 3.11-3: Housing Data (Massachusetts), 2019

Jurisdiction	**Housing Units**	**Seasonal Vacant Units**	**Vacant Units (Non-Seasonal)**	**Percent Non-Seasonal Vacancy**	**Median Value (Owner-Occupied)**	**Median Monthly Rent (Renter-Occupied)**
Massachusetts	2,897,259	127,398	152,364	5.3%	$ 381,600	$ 1,282
Barnstable County	163,557	62,643	6,591	4.0%	$ 393,500	$ 1,311
Bristol County	235,275	2,892	14,471	6.2%	$ 299,800	$ 901
Dukes County	17,902	10,681	456	2.5%	$ 699,500	$ 1,459
Nantucket County	12,345	7,860	772	6.3%	$ 1,084,700	$ 1,764
Essex County	312,992	5,506	18,790	6.0%	$ 409,900	$ 1,241

Source: U.S. Census Bureau 2020a

Table 3.11-4 summarizes the employment characteristics of residents of Barnstable, Bristol, Dukes, and Nantucket counties and Massachusetts as a whole. Table 3.11-5 summarizes the characteristics of jobs held in those counties and Massachusetts, regardless of where employees live. Approximately 14 percent of Massachusetts residents are employed in the professional, scientific, management, administrative, and waste management services industries (Table 3.11-4). Arts, entertainment, and recreation, and accommodation and food services jobs account for approximately 9 percent of employment for Massachusetts residents, compared to nearly 12, 8, and 10 percent in Barnstable, Dukes, and Nantucket counties, respectively (Table 3.11-4).

Table 3.11-4: Employment of Residents, By Industry (Massachusetts), 2019

Industry	Massachusetts Total	Barnstable County	Bristol County	Dukes County	Nantucket County	Essex County
Agriculture, forestry, fishing, and hunting	14,795	1,094	1,771	242	100	1,723
Construction	205,718	10,411	21,691	1,280	1,011	20,963
Manufacturing	317,827	4,104	31,395	261	168	44,605
Wholesale trade	78,806	2,038	9,081	161	168	10,992
Retail trade	370,824	14,461	36,337	789	812	41,277
Transportation, warehousing, and utilities	140,484	3,975	12,547	490	165	14,548
Information	82,102	1,833	4,478	163	39	10,461
Finance, and insurance, real estate	265,085	6,262	16,652	589	468	28,701
Professional, scientific, management; administrative and waste management services	506,967	12,766	25,915	1,162	1,030	43,733
Educational services, and health care and social assistance	1,018,564	25,464	76,736	2,022	1,162	89,018
Arts, entertainment, and recreation, and accommodation and food services	312,504	12,376	24,859	691	659	29,382
Other services, except public administration	161,589	5,783	11,939	523	327	16,529
Public administration	137,110	5,148	11,269	357	309	14,658
Total	**3,612,375**	**105,715**	**284,670**	**8,730**	**6,418**	**366,590**

Source: U.S. Census Bureau 2020a

Table 3.11-5: At-Place Employment, By Industry (Massachusetts), 2019

Industry	Massachusetts Total	Barnstable County	Bristol County	Dukes County	Nantucket County	Essex County
Agriculture, forestry, fishing and hunting	1,152	111	148	17	ND	4,202
Mining, quarrying, and oil and gas extraction	809	51	49	804	ND	1,533
Utilities	12,527	226	497	123	ND	9,615
Construction	151,366	6,164	10,766	66	954	88,885
Manufacturing	233,428	2,069	24,323	1,007	63	159,421
Wholesale trade	150,935	1,432	15,132	205	39	35,509
Retail trade	363,220	14,998	34,118	157	887	101,930
Transportation and warehousing	102,311	2,179	8,550	219	132	47,599
Information	123,296	1,301	2,874	169	94	24,310
Finance and insurance	187,058	2,017	4,116	246	96	111,809
Real estate and rental and leasing	52,199	1,385	1,910	17	131	22,549
Professional, scientific, and technical services	315,966	4,757	5,593	804	236	106,357
Management of companies and enterprises	111,216	1,005	4,773	ND	36	2,375
Administrative and support and waste management and remediation services	214,224	3,415	9,918	464	501	41,783
Educational services	230,028	1,635	5,362	58	106	120,811
Health care and social assistance	625,474	15,761	41,948	832	562	186,794
Arts, entertainment, and recreation	66,150	1,904	3,632	346	261	27,871
Accommodation and food services	316,291	12,574	21,720	626	664	45,886
Other services (except public administration)	128,034	4,086	7,968	344	233	46,896
Industries not classified	688	46	49	464	1	54,495
Total	**3,386,372**	**77,116**	**203,446**	**5,709**	**5,009**	**1,240,630**

Source: U.S. Census Bureau 2020a
ND = no data

NOAA tracks economic activity dependent upon the ocean in its "Ocean Economy" data, which generally include commercial fishing and seafood processing, marine construction, commercial shipping and cargo handling facilities, ship and boat building, marine minerals, harbor and port authorities, passenger transportation, boat dealers, and coastal recreation and tourism, among others. Table 3.11-6 reports data on the Ocean Economy as a whole in terms of gross domestic product (GDP) and employment; Table 3.11-7 reports employment by industry. In Barnstable, Dukes, and Nantucket counties, recreation and tourism accounted for approximately 89, 91, and 93 percent of the overall Ocean Economy GDP (NOAA 2019c). This category includes recreational and charter fishing, as well as commercial ferry services based in Hyannis Harbor and Woods Hole, which provide service to Nantucket, Martha's Vineyard, and other surrounding locations. The Woods Hole, Martha's Vineyard, and Nantucket Steamship Authority generated over $110 million in revenues in 2019 with almost 3,004,436 passenger trips (Steamship Authority 2020).

Table 3.11-6: Ocean Economy Data for Geographic Analysis Area Counties (Massachusetts), 2018

Jurisdiction	Ocean Economy GDP,[a] All Ocean Sectors	Ocean Economy GDP, Recreation and Tourism Sector[b]	Ocean Economy GDP, Living Resources Sector[b]	Total County GDP (Coastal Economy, Employment Data) Total, All Industries[c]	Ocean Economy GDP, as Percent of Total County GDP (%)[d]
Barnstable County	$1,324,724,000	$1,111,159,000	$77,672,000	$10,448,424,257	10%
Bristol County	$741,180,000	$107,444,000	$586,309,000	$25,768,897,279	3%
Dukes County	$130,390,000	$122,702,000	$6,934,000	$1,051,674,934	8%
Nantucket County	164,622,000	161,463,000	2,703,000	976,566,296	11%
Essex County	43,968,731,674	813,227,000	187,487,000	1,039,495,000	2%

Source: NOAA 2019c, 2019d

GDP = gross domestic product (U.S. dollars)
[a] GDP calculated as Ocean Economy Employment Data GDP plus Self-Employed Workers Gross Receipts
[b] Search Parameters: Ocean Economy (Employment Data); Ocean Economy Geographies (NOAA 2019c); Ocean Economy (Self-Employed); Ocean Economy Geographies (NOAA 2019d)
[c] Search Parameters: Coastal Economy (Employment Data); Coastal Shoreline Counties; Total, all industries (NOAA 2019e)
[d] Total GDP by county retrieved from U.S. Bureau Economic Analysis data (U.S. BEA 2020).

Table 3.11-7: Ocean Economy Employment[a] by Industry (Massachusetts), 2018

Jurisdiction	Marine Construction	Living Resources[b]	Offshore Mineral Extraction	Ship and Boat Building	Recreation and Tourism	Marine Transportation	Total, all Sectors[c]
Barnstable County	114	1,168	4	29	17,222	710	19,247
Bristol County	27	764	6	360	3,006	78	6,964
Dukes County	0[a]	111	0	6	1,424	18	1,561
Nantucket County	0	104	0	0	1,709	16	1,833
Essex County	121	1,230	ND	ND	17,617	306	19,274

Source: NOAA 2019c, 2019d

[a] For sectors showing no employment, data for certain businesses may have been suppressed because the number of businesses was too small to report based on privacy. This also results in total employment exceeding the sum of the sectors.
[b] Total employment calculated as All Ocean Sectors Employment (NOAA 2019c) plus All Ocean Sectors Self-Employed Workers (NOAA 2019d).
[c] "Living resources" includes fishing, aquaculture, seafood processing, and seafood markets.

The living resource sector of the Ocean Economy includes commercial fishing, aquaculture, seafood processing, and seafood markets. Although the number employed or self-employed in this sector in

Barnstable, Dukes, and Nantucket counties is minor compared to recreation and tourism (Table 3.11-7), local fishing fleets form an important part of the identity and tourist attraction of local communities. As an example, the Town of Barnstable was host to a commercial fishing fleet of 27 vessels in 2014, of which 20 were classified as small vessels (less than 50 feet) (NEFSC 2019). Landed fish values in 2014 for the Town of Barnstable range from $0.44 million to $5.8 million depending on species (NEFSC 2019). Self-employed workers and company employees employed in the living resources sector are shown in Table 3.11-8.

Table 3.11-8: Employment and Wages for Ocean Economy Living Resource Industries (Massachusetts), 2018

	Ocean Economy Living Resources Sector				**All Industry Sectors**	
	Company Employees		**Self-Employed Workers**		**All Workers**	
County	**Total Number**	**Average Wage**[a]	**Total Number**	**Average Gross Receipts**[b]	**Total Employment**	**Average Wage**
Barnstable	347	$43,078	821	$54,189	97,408	$47,903
Bristol	2,661	$76,682	764	$98,421	228,565	$50,349
Dukes	36	$60,056	96	$31,677	9,016	$52,092
Nantucket	1,230	$72,600	39	$59,923	7,577	$57,559
Essex	8	$25,375	691	$61,670	325,671	$60,294
Total/Average	**4,282**	**$55,558**	**2,411**	**$61,176**	**668,237**	**$53,639**

Sources: NOAA 2022c, 2022d, 2022e

[a] Average wage is calculated as total wages divided by total number of employees.
[b] Average gross receipts are calculated as total gross receipts divided by number of self-employed workers.

The applicant would use Vineyard Haven Harbor on Martha’s Vineyard as an operations facility for the proposed Project (COP Appendix III-I; Epsilon 2022a).

Menemsha, located in Dukes County, Massachusetts, is an example of a fishing community with established cultural identities and place attachments strongly correlated with the fishing economy. Menemsha is a community with great social pride for its fishing history. Place attachments can be defined as connections to physical and social settings that provide social and psychological benefits. Factors related to place attachments can impact well-being of individuals and the community as a whole (Khakzad and Griffith 2016). The NMFS Social Indicator Map classifies fishing communities in Barnstable, Dukes, and Nantucket counties as having varying levels of social vulnerability, in part based on commercial fishing engagement and reliance (NMFS 2019). Barnstable and Nantucket were rated high on commercial fishing engagement and reliance. The communities of Chilmark and Sandwich were rated medium to low for commercial fishing engagement and low for commercial fishing reliance.

Bristol County, Massachusetts

Bristol County is a manufacturing center and has an ocean-based economy dominated by shipping, seafood processing and commercial fishing. New Bedford in Bristol County is a nationally important commercial fishing center. Bristol County is more densely populated than Massachusetts as a whole and had lower per capita income and housing values. In 2018, Ocean Economy activities accounted for 3 percent of Bristol County’s GDP, and employed approximately 6,964 individuals, including self-employed individuals (Table 3.11-7). Commercial fishing, aquaculture, and seafood processing accounted for 87 percent of Bristol County’s total Ocean Economy value (NOAA 2019c).

The Port of New Bedford is a full-service port with well-established fishing and cargo handling industries. The port is an international seafood hub and the highest-grossing commercial fishing port in the United States (Harriman et al. 2020; New Bedford Port Authority 2018). The Port of New Bedford generated 14,429 jobs in 2018 (direct, indirect, and induced),[23] mostly from commercial fishing and seafood processing activity (Martin Associates and Foth-CLE Engineering Group 2019). The seafood processing industry at New Bedford handles seafood landed at New Bedford Harbor, as well as seafood from other domestic and international sources. An additional 26,499 related jobs were generated by downstream logistics operations in seafood processing, after the seafood leaves the port processing operations and cold storage facilities (Martin Associates and Foth-CLE Engineering Group 2019).

The applicant may use the Marine Commerce Terminal (MCT) at the Port of New Bedford, other areas at the Port of New Bedford, Brayton Point, and the Fall River Terminal in Bristol County to support proposed Project construction and may also use the MCT as an operations facility (COP Volume III, Section 7.7 and Appendix III-I; Epsilon 2022a). The recent history of industrial activity in these locations suggests the presence of a skilled workforce consistent with proposed Project needs (MassCEC 2022).

NMFS classifies fishing communities in New Bedford and Fairhaven as having high commercial fishing engagement and medium (Fairhaven) to low (New Bedford) reliance (NMFS 2019). Westport and Fall River were classified as having medium-high commercial fishing engagement, and low (Westport) and medium (Fall River) commercial fishing reliance. Other communities in Bristol County are identified as having medium to low ratings in both categories (NMFS 2019).

Essex County, Massachusetts

Essex County is located along Massachusetts Bay between Boston and the New Hampshire state border. The county is traditionally known for shipbuilding and tourism. Essex County is more densely populated than Massachusetts as a whole and has a lower per capita income (Table 3.11-1) and a higher median home value (Table 3.11-3). The Ocean Economy in Essex County employs over 20,000 individuals and accounted for over $1 billion of the county's overall GDP in 2018, equating to 3.4 percent of total GDP (FRED 2022; NOAA 2022f). Additionally, in 2018 the recreation and tourism sector employed 91 percent of Essex County's Ocean Economy workforce (NOAA 2019c). The applicant is considering using Salem Harbor in Essex County to support proposed Project construction (COP Volume III, Section 7.7; Epsilon 2022a). Approximately 36 miles northeast of Boston, Salem Harbor contains commercial, recreational, and water transportation facilities (COP Volume I, Section 3.2; Epsilon 2022a).

3.11.1.3 Providence and Washington Counties, Rhode Island

Both Providence and Washington counties have diverse economies. Their ocean-based economy sectors include shipping and commercial fishing in addition to tourism-related economic activity. Point Judith in Washington County is a center for the regional commercial and recreational for-hire fishing industries.

Providence County is Rhode Island's largest county in terms of population and is home to over 60 percent of Rhode Island's residents (Table 3.11-9). Providence County's housing values and per capita income are slightly lower than the state average, while unemployment is higher than the state average (Table 3.11-9). Washington County has a lower population and population density than both Providence County and the state of Rhode Island as a whole. The population of Rhode Island increased slightly from 2000 to 2019; Providence and Washington counties grew slightly faster (Table 3.11-10).

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[23] The terms "direct," "indirect," and "induced" are commonly used both within and outside the NEPA context to describe economic impacts and are, thus, used in this section. The remainder of the EIS does not distinguish between direct and indirect impacts.

Table 3.11-9: Demographic Data (Rhode Island), 2019

Jurisdiction	Population (2019)	Population Density (persons per square mile)[a]	Per Capita Income (2019)	Total Employed (2019)	Unemployment Rate (2019)
Rhode Island	1,057,231	870.9	$36,121	262,281	5.4%
Providence County	635,737	1,552.5	$31,522	154,655	5.9%
Washington County	126,060	382.9	$42,869	31,854	6.1%

Source: U.S. Census Bureau 2020a

[a] Population density is based on the 2019 population estimates divided by the square miles of each county (World Media Group 2022).

Table 3.11-10: Demographic Trends (Rhode Island), 2000–2019

Jurisdiction	Population				2019 Population by Age			
	2000	2010	2019	Change 2000-2019	Under Age 18 (%)	Age 18-64 (%)	Age 65 or Older (%)	Median Age
Rhode Island	1,048,319	1,052,567	1,057,231	1.1%	19.3%	63.0%	17.7%	39.9
Providence County	621,602	626,667	635,737	2.8%	20.5%	63.9%	15.6%	37.4
Washington County	123,546	126,242	126,060	1.6%	16.8%	42.9%	19.9%	44.6

Source: U.S. Census Bureau 2020b

Rhode Island has just under 17,500 seasonal vacant units, 63 percent of which are located in Washington County (Table 3.11-11). More than 17 percent of the homes in Washington County are seasonally occupied, and the median home value and rent in Washington County are substantially higher than both Providence County and the state as a whole.

Table 3.11-11: Housing Data (Rhode Island), 2019

Jurisdiction	Housing Units	Seasonal Vacant Units	Vacant Units (Non-Seasonal)	Percent Non-Seasonal Vacancy	Median Value (Owner-Occupied)	Median Monthly Rent (Renter-Occupied)
Rhode Island	468,335	17,478	40,368	8.6%	$ 261,900	$ 1,004
Providence County	266,330	1,174	27,185	10.2%	$ 233,500	$ 967
Washington County	64,016	11,074	3,840	6.0%	$ 343,000	$ 1,133

Source: U.S. Census Bureau 2020a

A majority of residents in Washington County, Providence County, and the state of Rhode Island are employed in the educational services, and health care and social assistance industries (Tables 3.11-12 and 3.11-13). Approximately 12.7 percent of residents in Washington County are employed in the arts, entertainment, and recreation, and accommodation and food services industries, higher than the 9.8 percent employed in Providence County and 10.3 percent employed in Rhode Island as a whole.

Table 3.11-12: Employment of Residents, By Industry (Rhode Island), 2019

Industry	Rhode Island Total	Providence County	Washington County
Agriculture, forestry, fishing, and hunting	2,397	965	669
Construction	29,358	16,199	3,949
Manufacturing	57,803	36,160	6,825
Wholesale trade	12,688	7,558	1,404
Retail trade	62,821	39,595	6,988
Transportation, warehousing, and utilities	21,433	13,040	1,951
Information	8,360	5,030	939
Finance, and insurance, real estate	36,509	20,992	3,815
Professional, scientific, and management, and administrative and waste management services	54,829	31,518	6,741
Educational services, and health care and social assistance	146,688	85,795	18,155
Arts, entertainment, and recreation, and accommodation and food services	55,466	30,923	8,242
Other services, except public administration	24,034	14,625	2,791
Public administration	21,492	11,600	2,526
Total	**533,878**	**314,000**	**64,995**

Source: U.S. Census Bureau 2020a

Table 3.11-13: At-Place Employment, By Industry (Rhode Island), 2019

Industry	Rhode Island Total	Providence County	Washington County
Agriculture, forestry, fishing and hunting	173	22	67
Mining, quarrying, and oil and gas extraction	148	97	44
Utilities	1,292	1,101	95
Construction	19,904	12,262	1,939
Manufacturing	39,469	22,087	8,587
Wholesale trade	20,075	12,020	2,813
Retail trade	47,840	24,644	6,521
Transportation and warehousing	12,129	6,466	614
Information	6,625	4,085	288
Finance and insurance	31,771	23,874	956
Real estate and rental and leasing	5,386	3,153	368
Professional, scientific, and technical services	23,070	12,959	1,670
Management of companies and enterprises	14,557	11,783	953
Administrative and support and waste management and remediation services	24,879	15,638	1,212
Educational services	30,312	24,072	557
Health care and social assistance	87,067	58,097	7,359
Arts, entertainment, and recreation	9,150	5,374	1,396
Accommodation and food services	52,985	29,373	5,963
Other services (except public administration)	18,073	10,926	1,855
Industries not classified	43	15	3
Total	**444,948**	**278,048**	**43,260**

Source: U.S. Census Bureau 2020a

In 2018, Ocean Economy activities accounted for 18 percent of the Washington County's total GDP (Table 3.11-14). Washington County has a diverse Ocean Economy; recreation and tourism accounted for 18 percent of the county's total Ocean Economy value and 51 percent of Ocean Economy employment, while the living resources sector accounted for 1 percent of the Ocean Economy value and 6 percent of employment (Table 3.11-15).

Statewide, Rhode Island's primary sectors in the total Ocean Economy value of $3.2 billion in 2018 were recreation and tourism (58.2 percent), marine transportation (10.2 percent), and living resources (3.4 percent). A 2018 study estimated that the commercial seafood industry statewide generated 3,147 jobs and $538 million in sales in 2016, with commercial fishing providing the highest number of firms and employees (Sproul and Michaud 2018). Self-employed workers and company employees employed in the living resources sector are shown in Table 3.11-16.

Table 3.11-14: Ocean Economy Data for Geographic Analysis Area Counties (Rhode Island), 2018

Jurisdiction	Ocean Economy GDP,[a] All Ocean Sectors	Ocean Economy GDP, Recreation and Tourism Sector[b]	Ocean Economy GDP, Living Resources Sector[b]	Total County GDP (Coastal Economy, Employment Data) Total, All Industries[c]	Ocean Economy GDP, as Percent of Total County GDP (%)[d]
Providence County	816,912,000	707,538,000	9,696,000	38,331,959,740	2%
Washington County	1,235,079,000	329,308,000	38,905,000	6,317,811,368	18%

Source: NOAA 2019c, 2019d

GDP = gross domestic product (U.S. dollars)
[a] GDP calculated as Ocean Economy Employment Data GDP plus Self-Employed Workers Gross Receipts
[b] Search Parameters: Ocean Economy (Employment Data); Ocean Economy Geographies (NOAA 2019c); Ocean Economy (Self-Employed); Ocean Economy Geographies (NOAA 2019d)
[c] Search Parameters: Coastal Economy (Employment Data); Coastal Shoreline Counties; Total, all industries (NOAA 2019e)
[d] Total GDP by county retrieved from U.S. Bureau Economic Analysis data (U.S. BEA 2020).

Table 3.11-15: Ocean Economy Employment[a] for Geographic Analysis Area Counties by Industry (Rhode Island), 2018

Jurisdiction	Marine Construction	Living Resources[b]	Offshore Mineral Extraction	Ship and Boat Building	Recreation and Tourism	Marine Transportation	Total, all Sectors[c]
Providence County	41	188	6	4	14,950	1,014	16,541
Washington County	68	757	0	3	6,104	45	11,896

Source: NOAA 2019c, 2019d

[a] For sectors showing no employment, data for certain businesses may have been suppressed because the number of businesses was too small to report based on privacy. This also results in total employment exceeding the sum of the sectors.
[b] Total employment calculated as All Ocean Sectors Employment (NOAA 2019c) plus All Ocean Sectors Self-Employed Workers (NOAA 2019d).
[c] "Living resources" includes fishing, aquaculture, seafood processing, and seafood markets.

Table 3.11-16: Employment and Wages for Ocean Economy Living Resource Industries (Rhode Island), 2018

	Ocean Economy Living Resources Sector				**All Industry Sectors**	
	Company Employees		**Self-Employed Workers**		**All Workers**	
County	**Total Number**	**Average Wage**[a]	**Total Number**	**Average Gross Receipts**[b]	**Total Employment**	**Average Wage**
Providence	85	$30,753	103	$30,738	287,533	$55,649
Washington	267	$70,644	490	$79,398	53,170	$49,601
Total/Average	**352**	**$50,699**	**593**	**$55,068**	**340,703**	**$52,625**

Sources: NOAA 2022c, 2022d, 2022e

[a] Average wage is calculated as total wages divided by total number of employees.
[b] Average gross receipts are calculated as total gross receipts divided by number of self-employed workers.

The applicant is considering using the Port of Providence (ProvPort) and the South Quay Terminal (in the Providence area) in Providence County and the Port of Davisville in Washington County to support proposed Project construction (COP Volume III, Section 7.7; Epsilon 2022a). ProvPort is a privately owned marine terminal that has generated approximately $164 million in economic output for Providence and $211 million for the state of Rhode Island since 1994 (COP Volume III, Section 7.1.1; Epsilon 2022a). In 2018, Ocean Economy activities accounted for 2 percent of Providence County's GDP (Table 3.11-14), about 87 percent of which was associated with recreation and tourism (NOAA 2019c).

The Port of Davisville in Washington County accounts for over 1,500 direct and indirect jobs (COP Volume I, Section 7.1; Epsilon 2022a). Washington County also contains Point Judith, a center of the Rhode Island fishing industry. Washington County is also home to the first offshore wind farm in the United States, which has become a source of income for the Washington County tourism industry.

NMFS classifies fishing communities in Bristol County, Rhode Island, as having very low commercial and recreational engagement and reliance. Newport County is classified as having low commercial and recreational fishing reliance and medium to low commercial and recreational engagement. Providence County is classified as having low commercial fishing engagement and reliance. The communities of North Kingstown and Narragansett/Point Judith were identified as having medium commercial fishing engagement and low reliance. Other communities in Providence and Washington counties are identified as having medium to low ratings in both categories (NMFS 2019).

3.11.1.4 Fairfield and New London Counties, Connecticut

Fairfield and New London counties are located along Long Island Sound in southern Connecticut. Fairfield County sits in southwestern Connecticut and shares a border with New York and is close to New York City. New London County is located in southeastern Connecticut and shares its eastern border with Rhode Island. Table 3.11-17 shows additional demographic data for Connecticut and Fairfield and New London counties. Fairfield County's population density is almost two times the population density of Connecticut as a whole and has a higher per capita income than both the state and New London County. The populations of Fairfield County, New London County, and the State of Connecticut increased overall from 2000 to 2019 (Table 3.11-18). Fairfield County experienced the highest growth (7 percent) and now contains over 26 percent of Connecticut's population.

Table 3.11-17: Demographic Data (Connecticut), 2019

Jurisdiction	Population (2019)	Population Density (persons per square mile)[a]	Per Capita Income (2019)	Total Employed (2019)	Unemployment Rate (2019)
Connecticut	3,565,287	648	$36,775	1,765,549	7.6%
Fairfield County	943,332	1,116	$48,295	439,341	7.6%
New London County	265,206	355	$32,888	134,193	6.2%

Source: U.S. Census Bureau 2020a

[a] Population density is based on the 2019 population estimates divided by the square miles of each county (World Media Group 2022).

Table 3.11-18: Demographic Trends (Connecticut), 2000–2019

Jurisdiction	Population				2019 Population by Age			
	2000	2010	2019	Change 2000-2019	Under Age 18 (%)	Age 18-64 (%)	Age 65 or Older (%)	Median Age
Connecticut	3,405,565	3,577,073	3,565,287	5%	20.4%	62%	17.6%	41.2
Fairfield County	882,567	918,714	943,332	7%	22.2%	61%	16.3%	40.6
New London County	259,088	274,055	265,206	2%	19.2%	62%	18.8%	41.9

Source: U.S. Census Bureau 2020b

New London County has a higher percentage of non-seasonal vacant units (8.6 percent) than Fairfield County (7.2 percent) and Connecticut as a whole (7.7 percent) (Table 3.11-19).

Table 3.11-19: Housing Data (Connecticut), 2019

Jurisdiction	Housing Units	Seasonal Vacant Units	Vacant Units (Non-Seasonal)	Percent Non-Seasonal Vacancy	Median Value (Owner-Occupied)	Median Monthly Rent (Renter-Occupied)
Connecticut	1,516,629	29,521	116,362	7.7%	$275,400	1,180
Fairfield County	372,565	5,484	26,892	7.2%	$428,500	1,499
New London County	123,426	5,033	10,566	8.6%	$241,700	1,130

Source: U.S. Census Bureau 2020a

Educational services and the health care and social assistance industry employ the largest number of residents of Connecticut, as well as Fairfield and New London counties (Table 3.11-20). More than 12 percent of jobs in Fairfield County are in health care and social assistance, while more than 18 percent of New London County jobs are in manufacturing (Table 3.11-21).

Table 3.11-20: Employment of Residents, By Industry (Connecticut), 2019

Industry	Connecticut Total	Fairfield County	New London County
Agriculture, forestry, fishing, and hunting	7,173	1,411	822
Construction	110,308	30,948	7,739
Manufacturing	188,968	37,712	18,304
Wholesale trade	42,782	12,002	2,187
Retail trade	190,314	48,246	13,844
Transportation, warehousing, and utilities	78,107	17,655	5,268
Information	36,880	12,085	1,774
Finance, and insurance, real estate	163,661	57,138	5,913
Professional, scientific, and management, and administrative and waste management services	211,665	75,860	11,865
Educational services, and health care and social assistance	478,318	109,514	32,885
Arts, entertainment, and recreation; accommodation and food services	149,684	38,675	18,868
Other services, except public administration	82,940	23,340	5,738
Public administration	66,725	12,171	6,865
Total	**1,807,525**	**476,757**	**132,072**

Source: U.S. Census Bureau 2020a

Table 3.11-21: At-Place Employment, By Industry (Connecticut), 2019

Industry	Connecticut Total	Fairfield County	New London County
Agriculture, forestry, fishing and hunting	4,202	642	496
Mining, quarrying, and oil and gas extraction	1,533	265	154
Utilities	9,615	1,808	1,603
Construction	88,885	26,516	5,962
Manufacturing	159,421	30,628	16,387
Wholesale trade	35,509	11,448	1,114
Retail trade	101,930	25,936	8,595
Transportation and warehousing	47,599	11,999	1,705
Information	24,310	8,375	765
Finance and insurance	111,809	41,351	3,185
Real estate and rental and leasing	22,549	6,917	1,458
Professional, scientific, and technical services	106,357	38,306	6,335
Management of companies and enterprises	2,375	1,072	105
Administrative and support and waste management and remediation services	41,783	15,544	1,760
Educational services	120,811	24,546	8,145
Health care and social assistance	186,794	40,906	12,786
Arts, entertainment, and recreation	27,871	6,883	7,738
Accommodation and food services	45,886	13,260	3,703
Other services (except public administration)	46,896	12,986	3,571
Public administration	54,495	10,043	4,540
Total	**1,240,630**	**329,431**	**90,107**

Source: U.S. Census Bureau 2020a

The Ocean Economy provides over 17,000 jobs in Fairfield County and $1 billion of the county's overall GDP (Table 3.11-22). New London County has a lower population and overall GDP than Fairfield County; however, New London County's Ocean Economy GDP is twice that of Fairfield County (Table 3.11-22). Approximately 14 percent of New London County's overall GDP comes from the Ocean Economy. More than 20,000 individuals are employed in New London County's Ocean Economy sector (Table 3.11-23). More than 12,000 of these jobs, largely in the marine transportation subsector are suppressed (i.e., not reported) by NOAA for confidentiality purposes (NOAA 2019c), indicating a large number of small employers. Fairfield County's largest employment sector is tourism and recreation, accounting for over 17,000 jobs. Self-employed workers and company employees employed in the living resources sector are shown in Table 3.11-24.

Table 3.11-22: Ocean Economy Data for Geographic Analysis Area Counties (Connecticut), 2018

Jurisdiction	Ocean EconomyGDP,[a] All Ocean Sectors	Ocean Economy GDP, Recreation and Tourism Sector[b]	Ocean Economy GDP, Living Resources Sector[b]	Total County GDP (Coastal Economy, Employment Data) Total, All Industries[c]	Ocean Economy GDP, as Percent of Total County GDP (%)[d]
Fairfield County	1,157,101,000	17,390	126	92,932,974,479	1%
New London County	2,409,839,000	7,397	39	17,635,622,267	14%

Source: NOAA 2019c, 2019d

GDP = gross domestic product (U.S. dollars)
[a] GDP calculated as Ocean Economy Employment Data GDP plus Self-Employed Workers Gross Receipts
[b] Search Parameters: Ocean Economy (Employment Data); Ocean Economy Geographies (NOAA 2019c); Ocean Economy (Self-Employed); Ocean Economy Geographies (NOAA 2019d)
[c] Search Parameters: Coastal Economy (Employment Data); Coastal Shoreline Counties; Total, all industries (NOAA 2019e)
[d] Total GDP by county retrieved from U.S. Bureau Economic Analysis data (U.S. BEA 2020).

Table 3.11-23: Ocean Economy Employment[a] for Geographic Analysis Area Counties by Industry (Connecticut), 2018

Jurisdiction	Marine Construction	Living Resources[b]	Offshore Mineral Extraction	Ship and Boat Building	Recreation and Tourism	Marine Transportation	Total, all Sectors[c]
Fairfield County	113	126	ND	17	17,390	481	18,489
New London County	29	39	71	323	7,397	ND	20,431

Source: NOAA 2019c, 2019d

[a] For sectors showing no employment, data for certain businesses may have been suppressed because the number of businesses was too small to report based on privacy. This also results in total employment exceeding the sum of the sectors.
[b] "Living resources" includes fishing, aquaculture, seafood processing, and seafood markets.
[c] Total employment calculated as All Ocean Sectors Employment (NOAA 2019c) plus All Ocean Sectors Self-Employed Workers (NOAA 2019d).

Table 3.11-24: Employment and Wages for Ocean Economy Living Resource Industries (Connecticut), 2018

	Ocean Economy Living Resources Sector				All Industry Sectors	
	Company Employees		Self-Employed Workers		All Workers	
County	Total Number	Average Wage[a]	Total Number	Average Gross Receipts[b]	Total Employment	Average Wage
Fairfield	126	$44,746	68	$37,912	420,677	$86,216
New London	39	$29,153	118	$75,475	123,881	$55,559
Total/Average	**165**	**$36,950**	**186**	**$56,694**	**544,558**	**$70,888**

Sources: NOAA 2022c, 2022d, 2022e

[a] Average wage is calculated as total wages divided by total number of employees.
[b] Average gross receipts are calculated as total gross receipts divided by number of self-employed workers.

The applicant may use the Port of Bridgeport in Fairfield County and the New London State Pier in New London County to support proposed Project construction (COP Volume III, Section 7.7; Epsilon 2022a). The Port of Bridgeport is a deepwater port with industrial, commercial, and recreational uses. The applicant would use Bridgeport as an operations facility for the proposed Project (COP Appendix III-I; Epsilon 2022a). The New London State Pier is a deepwater port scheduled for redevelopment by the Connecticut Port Authority, Eversource, and Ørsted for the use of the Atlantic offshore wind industry as a whole (COP Volume III, Section 7.1; Epsilon 2022a).

3.11.1.5 New York

Kings and Richmond Counties, New York

Kings County (i.e., Brooklyn) and Richmond County (i.e., Staten Island) are two of New York City's five boroughs. Richmond and Kings counties are more densely populated than New York State as a whole (Table 3.11-25). Overall, the population for the State of New York and Kings and Richmond counties are growing (Table 3.11-26).

Table 3.11-25: Demographic Data (New York), 2020

Jurisdiction	Population (2020)	Population Density (persons per square mile)[a]	Per Capita Income (2020)	Total Employed (2020)	Unemployment Rate (2019)
New York	20,201,249	428	39,326	8,597,216	7.5%
Albany County	314,848	603	37,635	183,540	6.0%
Kings County	2,736,074	39,086	34,173	677,323	8.4%
Rensselaer County	161,130	247	35,903	45,372	7.3%
Richmond County	495,747	8,547	36,907	109,566	6.2%
Suffolk County	1,525,920	1,673	44,465	594,392	5.8%

Source: U.S. Census Bureau 2020a

[a] Population density is based on the 2020 population estimates divided by the square miles of each county (World Media Group 2022).

Table 3.11-26: Demographic Trends (New York), 2000–2019

Jurisdiction	Population				2019 Population by Age			
	2000	2010	2019	Change 2000-2019	Under Age 18 (%)	Age 18-64 (%)	Age 65 or Older (%)	Median Age
New York	18,976,457	19,392,283	19,453,561	3%	20.7%	62%	16.9%	39.2
Albany County	294,565	303,833	305,506	4%	18.3%	64%	17.5%	38.0
Kings County	2,465,326	2,508,340	2,559,903	4%	22.7%	63%	14.4%	35.6
Rensselaer County	152,538	159,428	158,714	4%	19.3%	63%	17.8%	39.7
Richmond County	443,728	469,363	476,143	7%	21.8%	62%	16.7%	40.0
Suffolk County	1,419,369	1,494,434	1,476,601	4%	20.9%	62%	17.3%	41.8
New York	18,976,457	19,392,283	19,453,561	3%	20.7%	62%	16.9%	39.2

Source: U.S. Census Bureau 2020b

Kings County has over 1 million housing units; of these, 9,703 are seasonal (Table 3.11-27). The median home value in Kings County is twice the New York State average, and the median monthly rent price in both Richmond and Kings County is higher than the New York state average (Table 3.11-27).

Table 3.11-27: Housing Data (New York), 2019

Jurisdiction	Housing Units	Seasonal Vacant Units	Vacant Units (Non-Seasonal)	Percent Non-Seasonal Vacancy	Median Value (Owner-Occupied)	Median Monthly Rent (Renter-Occupied)
New York	8,322,722	348,027	631,461	7.6%	$313,700	$1,280
Albany County	141,553	1,896	13,117	9.3%	$222,500	$1,022
Kings County	1,044,493	9,703	76,223	7.3%	$706,000	$1,426
Rensselaer County	73,011	1,459	6,646	9.1%	$188,700	$973
Richmond County	180,325	932	13,147	7.3%	$504,800	$1,319
Suffolk County	575,960	53,765	32,894	5.7%	$397,400	$1,742

Source: U.S. Census Bureau 2020a

Over 2 million New York state residents are employed in the educational services, and health care and social assistance industry (Table 3.11-28). There are more than 640,000 jobs in New York in professional, scientific, and technical roles statewide, of which 12,761 are in Richmond County and more than 103,000 are in Kings County (Table 3.11-29). More than 17 percent of jobs in Richmond County and more than 14 percent of Kings County jobs are in health care and social assistance.

Table 3.11-28: Employment of Residents, By Industry (New York), 2019

Industry	Total	Albany County	Kings County	Rensselaer County	Richmond County	Suffolk County
Agriculture, forestry, fishing, and hunting	54,877	673	1,159	585	80	2,568
Construction	533,243	6,957	62,823	5,287	15,075	57,640
Manufacturing	654,700	8,075	50,949	5,921	6,394	57,424
Wholesale trade	254,079	3,231	28,328	2,069	4,504	27,026
Retail trade	955,413	15,768	100,751	8,892	19,976	84,979
Transportation, warehousing, and utilities	479,165	6,557	71,684	3,502	14,903	41,407
Information	282,991	3,723	43,651	1,951	5,416	22,671
Finance, and insurance, real estate	775,195	12,335	90,061	5,144	25,398	55,871
Professional, scientific, and management; administrative and waste management services	980,577	14,546	129,028	7,204	21,354	80,772
Educational services, and health care and social assistance	2,409,408	43,265	303,204	21,314	56,139	182,393
Arts, entertainment, and recreation, and accommodation and food services	766,879	12,025	96,274	6,092	12,773	47,483
Other services, except public administration	453,649	6,676	59,783	3,453	9,437	30,158
Public administration	445,823	20,988	48,465	9,184	16,437	37,932
Total	**9,045,999**	**154,819**	**1,086,160**	**80,598**	**207,886**	**728,324**

Source: U.S. Census Bureau 2020a

Table 3.11-29: At-Place Employment, By Industry (New York), 2019

Industry	Total	Albany County	Kings County	Rensselaer County	Richmond County	Suffolk County
Agriculture, forestry, fishing and hunting	36,602	445	517	561	462	1,211
Mining, quarrying, and oil and gas extraction	5,482	0	264	0	268	41
Utilities	54,205	719	4,408	748	1,234	4,250
Construction	448,497	5,682	53,539	5,274	14,335	49,865
Manufacturing	475,098	7,159	25,838	6,175	5,610	43,848
Wholesale trade	183,725	2,335	20,845	1,115	3,465	21,162
Retail trade	538,982	5,435	74,649	3,801	10,896	46,894
Transportation and warehousing	374,835	3,160	65,569	1,632	11,360	30,171
Information	214,207	1,557	48,589	843	3,729	12,778
Finance and insurance	475,900	7,731	46,474	3,160	13,896	36,690
Real estate and rental and leasing	163,744	2,296	26,371	755	5,101	9,222
Professional, scientific, and technical services	641,693	11,897	103,321	4,518	12,761	45,501
Management of companies and enterprises	12,046	283	1,442	0	50	513
Administrative and support and waste management and remediation services	240,333	2,983	32,108	1,502	7,474	19,761
Educational services	698,544	9,645	84,487	6,672	20,763	62,264
Health care and social assistance	1,177,346	17,109	169,005	9,490	30,224	91,817
Arts, entertainment, and recreation	134,657	1,439	22,246	358	1,626	8,664
Accommodation and food services	351,526	4,429	51,017	1,291	7,278	19,574
Other services (except public administration)	274,403	4,280	38,212	1,921	4,261	21,285
Industries not classified	393,021	17,898	40,202	6,725	15,594	33,516
Total	**6,894,846**	**106,482**	**909,103**	**56,541**	**170,387**	**559,027**

Source: U.S. Census Bureau 2020a

The applicant is considering using up to four ports in the greater New York City area for proposed Project construction. These include the South Brooklyn Marine Terminal and GMD Shipyard in Kings County, and the Arthur Kill and Homeport Pier ports in Richmond County (COP Volume III, Section 7.7; Epsilon 2022a).

Rensselaer and Albany Counties, New York

Rensselaer and Albany counties are in upstate New York along the Hudson River. Residents of Albany and Rensselaer counties are involved in various industries including government, education, healthcare, and technology (U.S. Census Bureau 2020a). Both counties rely minimally on the Ocean Economy, and data are limited, although the Ocean Economy in Albany County provides 594 jobs (Table 3.11-30).

The applicant is considering using three upstate New York ports during proposed Project construction staging in upstate New York: the Port of Coeymans and the Port of Albany in Albany County, and the New York Offshore Wind Port in Rensselaer County (COP Volume III, Section 7.7; Epsilon 2022a). The Port of Coeymans is 100 miles north of New York City and employs approximately 200 people (Carver Companies 2022). The Port of Albany is approximately 120 miles north of New York City and employs a crew of nine individuals (Port of Albany 2019). The Port of Albany recently acquired 80 acres of additional land, with plans to expand operations for offshore wind capabilities. The New York State Offshore Wind Port is approximately 110 miles from New York City and 9 miles north of Coeymans.

Suffolk County, New York

Suffolk County encompasses the central and eastern portion of Long Island. Educational services, and health care and social assistance industry employ the largest number of Suffolk County residents. The county also has a large number of seasonal vacant units, reflecting the importance of the recreation and tourism industry for Long Island (Table 3.11-27).

Over 43,000 residents in Suffolk County rely on occupations in the Ocean Economy, accounting for $3 billion of the county's overall GDP (NOAA 2022f). Approximately 36,385 individuals in the Ocean Economy workforce are employed in the marine recreation and tourism sector (87.9 percent of the overall workforce), with an additional 3,746 employed in the marine transportation sector (Tables 3.11-30 and 3.11-31). Self-employed workers and company employees employed in the living resources sector are shown in Table 3.11-32.

Table 3.11-30: Ocean Economy Employment for Geographic Analysis Area Counties by Industry (New York), 2018[a]

Jurisdiction	Marine Construction	Living Resources[b]	Offshore Mineral Extraction	Ship and Boat Building	Recreation and Tourism	Marine Transportation	Total, all Sectors[c]
Albany County	ND	ND	ND	ND	0	594	594
Kings County	ND	1,412	ND	ND	33,228	1,517	36,157
Rensselaer County	ND	ND	ND	ND	ND	ND	ND
Richmond County	166	72	ND	ND	8,359	283	8,880
Suffolk County	563	614	23	69	36,385	3,746	41,400

Source: NOAA 2019c, 2019d

ND = no data
[a] For sectors showing no employment, data for certain businesses may have been suppressed because the number of businesses was too small to report based on privacy. This also results in total employment exceeding the sum of the sectors.
[b] Total employment calculated as All Ocean Sectors Employment (NOAA 2019c) plus All Ocean Sectors Self-Employed Workers (NOAA 2019d).
[c] "Living resources" includes fishing, aquaculture, seafood processing, and seafood markets.

Table 3.11-31: Ocean Economy Data for Geographic Analysis Area Counties (New York), 2018

Jurisdiction	Ocean Economy GDP,[a] All Ocean Sectors	Ocean Economy GDP, Recreation and Tourism Sector[b]	Ocean Economy GDP, Living Resources Sector [b]	Total County GDP (Coastal Economy, Employment Data) Total, All Industries[c]	Ocean Economy GDP, as Percent of Total County GDP (%)[d]
Albany County	32,689,000	32,689,000	ND	ND	NA
Kings County	2,052,466,000	1,802,669,000	167,428,000	95,011,253,174	2%
Rensselaer County	ND	ND	ND	ND	NA
Richmond County	461,652,000	380,762,000	9,878,000	16,437,421,205	3%
Suffolk County	2,611,517,000	1,916,676,000	54,149,000	101,317,008,894	3%

Source: NOAA 2019c, 2019d

GDP = gross domestic product (U.S. dollars); NA = not applicable; ND = No data

[a] GDP calculated as Ocean Economy Employment Data GDP plus Self-Employed Workers Gross Receipts

[b] Search Parameters: Ocean Economy (Employment Data); Ocean Economy Geographies (NOAA 2019c); Ocean Economy (Self-Employed); Ocean Economy Geographies (NOAA 2019d)

[c] Search Parameters: Coastal Economy (Employment Data); Coastal Shoreline Counties; Total, all industries (NOAA 2019e)

[d] Total GDP by county retrieved from U.S. Bureau Economic Analysis data (U.S. BEA 2020).

Table 3.11-32: Employment and Wages for Ocean Economy Living Resource Industries (New York), 2018

	Ocean Economy Living Resources Sector				All Industry Sectors	
	Company Employees		Self-Employed Workers		All Workers	
County	Total Number	Average Wage[a]	Total Number	Average Gross Receipts[b]	Total Employment	Average Wage
Albany	ND	ND	19	$55790	223,634	$58,297
Kings	1,412	$43,645	89	$66,921	767261	$48,817
Rensselaer	ND	ND	ND	ND	53759	$51,568
Richmond	72	$54,681	27	$54,704	122908	$52,722
Suffolk	614	$37,340	693	$42,856	661066	$60,419
Total/Average	**2,098**	**$27,133**	**828**	**$44,054**	**1,828,628**	**$54,365**

Sources: NOAA 2022c, 2022d, 2022e

ND = no data

[a] Average wage is calculated as total wages divided by total number of employees.

[b] Average gross receipts are calculated as total gross receipts divided by number of self-employed workers.

The applicant is considering the East Shoreham site in Suffolk County to support proposed Project construction (COP Volume III, Section 7.7; Epsilon 2022a) and may use Greenpoint Harbor for operations (COP Appendix III-I; Epsilon 2022a). The East Shoreham facility may be used for both port usage and construction staging, and the Greenport Harbor facility would likely only be used for operations activities.

3.11.1.6 Gloucester County, New Jersey

Gloucester County is located in southwestern New Jersey, immediately south of and adjacent to Philadelphia. The county's western border is the Delaware River. Gloucester County's population density and per capita income are lower than the New Jersey State average (Tables 3.11-33 and 3.11-34). The population of Gloucester County has grown substantially since 2000.

Table 3.11-33: Demographic Data (New Jersey), 2019

Jurisdiction	Population (2019)	Population Density (persons per mi^2)[a]	Per Capita Income (2019)	Total Employed (2019)	Unemployment Rate (2019)
New Jersey	8,882,190	1,017	$34,858	4,230,560	7.8%
Gloucester County	291,636	859	$31,210	142,108	8.2%

Source: U.S. Census Bureau 2020a

[a] Population density is based on the 2019 population estimates divided by the square miles of each county (World Media Group 2022)

Table 3.11-34: Demographic Trends (New Jersey), 2000–2019

	Population				2019 Population by Age			
Jurisdiction	2000	2010	2019	Change 2000-2019	Under Age 18 (%)	Age 18–64 (%)	Age 65 or Older (%)	Median Age
New Jersey	8,414,350	8,801,624	8,882,190	6%	21.8%	62%	16.6%	40.2
Gloucester County	254,673	288,581	291,636	15%	21.6%	62%	16.2%	40.7

Source: U.S. Census Bureau 2020b

Gloucester County's median home value is substantially less than the New Jersey State average, although rents are more comparable (Table 3.11-35). The seasonal vacancy percentage in Gloucester County is substantially lower than the New Jersey average.

Table 3.11-35: Housing Data (New Jersey), 2019

Jurisdiction	Housing Units	Seasonal Vacant Units	Vacant Units (Non-Seasonal)	Percent Non-Seasonal Vacancy	Median Value (Owner-Occupied)	Median Monthly Rent (Renter-Occupied)
New Jersey	3,616,614	135,990	248,750	6.9%	$335,600	$1,334
Gloucester County	113,485	320	8,257	7.3%	$219,700	$1,225

Source: U.S. Census Bureau 2020a

Approximately 16 percent of Gloucester County's overall workforce is employed in the construction and manufacturing industries (Table 3.11-36), while more than half of Gloucester County jobs are in administrative and support and waste management and remediation services industry establishments (Table 3.11-37).

Table 3.11-36: Employment of Residents, By Industry (New Jersey), 2019

Industry	New Jersey Total	Gloucester County
Agriculture, forestry, fishing, and hunting	14,702	742
Construction	259,043	9,406
Manufacturing	396,329	13,438
Wholesale trade	160,966	5,808
Retail trade	469,625	18,443
Transportation, warehousing, and utilities	242,906	8,991
Information	134,690	3,045
Finance, and insurance, real estate	385,143	10,595
Professional, scientific, and management; administrative and waste management services	517,257	14,292
Educational services, and health care and social assistance	942,587	35,174
Arts, entertainment, and recreation, and accommodation and food services	325,783	10,106
Other services, except public administration	186,453	5,533
Public administration	195,076	6,535
Total	**4,230,560**	**142,108**

Source: U.S. Census Bureau 2020a

Table 3.11-37: At-Place Employment, By Industry (New Jersey), 2019

Industry	New Jersey Total	Gloucester County
Agriculture, forestry, fishing and hunting	10,897	268
Mining, quarrying, and oil and gas extraction	1,485	14
Utilities	31,014	2,193
Construction	219,414	8,780
Manufacturing	318,127	10,437
Wholesale trade	122,129	4,988
Retail trade	283,845	9,879
Transportation and warehousing	205,317	7,406
Information	85,434	2,338
Finance and insurance	265,605	6,336
Real estate and rental and leasing	61,867	1,383
Professional, scientific, and technical services	342,095	10,604
Management of companies and enterprises	7,203	166
Administrative and support and waste management and remediation services	131,262	2,608
Educational services	277,410	12,045
Health care and social assistance	446,028	17,193
Arts, entertainment, and recreation	50,689	1,727
Accommodation and food services	136,260	4,324
Other services (except public administration)	120,843	3,054
Public administration	165,967	4,944
Total	**5,940,389**	**202,159**

Source: U.S. Census Bureau 2020a

Nearly all of Gloucester County's Ocean Economy GDP is from the recreation and tourism industry (Table 3.11-38). The Ocean Economy accounts for approximately 5,500 jobs in the county, with 61 percent of those positions in the marine transportation sector (Table 3.11-39). Self-employed workers and company employees employed in the living resources sector are shown in Table 3.11-40.

Table 3.11-38: Ocean Economy Data for Geographic Analysis Area Counties (New Jersey), 2018

Jurisdiction	Ocean Economy GDP,[a] All Ocean Sectors	Ocean Economy GDP, Recreation and Tourism Sector[b]	Ocean Economy GDP, Living Resources Sector[b]	Total County GDP (Coastal Economy, Employment Data) Total, All Industries[c]	Ocean Economy GDP, as Percent of Total County GDP (%)[d]
Gloucester County	275,105,000	52,348,000	ND	416,820,000	2%

Source: NOAA 2019c, 2019d

GDP = gross domestic product (U.S. dollars); ND = no data

[a] GDP calculated as Ocean Economy Employment Data GDP plus Self-Employed Workers Gross Receipts

[b] Search Parameters: Ocean Economy (Employment Data); Ocean Economy Geographies (NOAA 2019c); Ocean Economy (Self-Employed); Ocean Economy Geographies (NOAA 2019d)

[c] Search Parameters: Coastal Economy (Employment Data); Coastal Shoreline Counties; Total, all industries (NOAA 2019e)

[d] Total GDP by county retrieved from U.S. Bureau Economic Analysis data (U.S. BEA 2020).

Table 3.11-39: Ocean Economy Employment[a] for Geographic Analysis Area Counties by Industry (New Jersey), 2018

Jurisdiction	Marine Construction	Living Resources[b]	Offshore Mineral Extraction	Ship and Boat Building	Recreation and Tourism	Marine Transportation	Total, all Sectors[c]
Gloucester County	283	15	ND	ND	1,528	3,439	5,579

Source: NOAA 2019c, 2019d

ND = no data

[a] For sectors showing no employment, data for certain businesses may have been suppressed because the number of businesses was too small to report based on privacy. This also results in total employment exceeding the sum of the sectors.

[b] Total employment calculated as All Ocean Sectors Employment (NOAA 2019c) plus All Ocean Sectors Self-Employed Workers (NOAA 2019d).

[c] "Living resources" includes fishing, aquaculture, seafood processing, and seafood markets.

Table 3.11-40: Employment and Wages for Ocean Economy Living Resource Industries (New Jersey), 2018

	Ocean Economy Living Resources Sector				All Industry Sectors	
	Company Employees		Self-Employed Workers		All Workers	
County	Total Number	Average Wage[a]	Total Number	Average Gross Receipts[b]	Total Employment	Average Wage
Gloucester	ND	ND	15	$46,533	110,526	$46,871

Sources: NOAA 2022c, 2022d, 2022e

ND = no data

[a] Average wage is calculated as total wages divided by total number of employees.

[b] Average gross receipts are calculated as total gross receipts divided by number of self-employed workers.

The applicant may use of the Port of Paulsboro (Paulsboro Marine Terminal) to support proposed Project construction. The Paulsboro Marine Terminal is part of the South Jersey Port Corporation, which manages and maintains seven ports in New Jersey (South Jersey Port Corporation 2022).

3.11.1.7 Employment and Economic Trends

Offshore wind is becoming a key industry for the Atlantic states and the nation. Several recent reports provide national estimates of employment and economic activity. While offshore wind component manufacture and installation capacity exists primarily outside the United States, domestic capacity is anticipated to increase. This EIS uses available data, analysis, and projections to make reasoned conclusions on potential economic and employment impacts within the geographic analysis area.

During the initial implementation of offshore wind projects along the U.S. northeast coast, a base level of 35 percent of jobs, with a high probability of up to 55 percent of jobs, would likely be sourced from within the United States (BVG 2017). The proportion of jobs filled within the United States would increase as the offshore wind energy industry grows due to growth of a supply chain and supporting industries along the east coast, as well as a growing number of local operations jobs for established wind facilities. By 2030 and continuing through 2056, approximately 65 to 75 percent of jobs associated with offshore wind are projected to be within the United States. Overseas manufacturers of components and specialized ships based overseas that are contracted for installation of foundations and WTGs would fill jobs outside of the United States (BVG 2017). As an example of the mix of local, national, and foreign job creation, for the 5-turbine Block Island Wind Farm, turbine blade manufacturing occurred in Denmark, generator and nacelle manufacturing occurred in France, tower component manufacturing occurred in Spain, and foundation manufacturing occurred in Louisiana (Gould and Cresswell 2017).

American Clean Power (ACP; formerly the American Wind Energy Association) estimated that the offshore wind industry would invest $80 to $106 billion in U.S. offshore wind development by 2030, including $28 to $57 billion invested within the United States, depending on installation levels and supply chain growth (other investment would occur in countries manufacturing or assembling wind energy components for U.S. based projects) (AWEA 2020, 2021). Economic and employment impacts would occur nationwide but be most concentrated in Atlantic coastal states that host offshore wind development. ACP lists over $1.3 billion in announced domestic investments in wind energy manufacturing facilities, ports, and vessel construction in Atlantic states (AWEA 2020). The ACP report analyzes a base scenario and a high scenario for offshore wind direct impacts, turbine and supply chain impacts, and induced impacts. The base scenario assumes 20 GW of offshore wind power by 2030 and domestic content increasing to 30 percent in 2025 and 50 percent in 2030 (AWEA 2021). The high scenario assumes 30 GW of offshore wind power by 2030 and domestic content increasing to 40 percent in 2025 and 60 percent in 2030. ACP estimates offshore wind energy development would support $25 billion in economic output and 83,000 jobs by 2030 (AWEA 2021). These estimates reflect state targets (at the time of publication of the ACP report) of 25,400 MW of offshore wind by 2035, based on commitments from Connecticut, Massachusetts, New Jersey, New York, and Virginia (AWEA 2021).

The ACP estimates are consistent with the University of Delaware (2021) projections, which estimate that deployment of 30 GW of planned and contracted offshore wind energy projects through 2030 would require capital, development, and operational expenditures of $109 billion over the next 10 years (University of Delaware 2021). The study notes that, while the offshore wind supply chain is global and expenditures would be directed to both domestic and foreign sources, a growing number of U.S. suppliers are preparing to enter the industry.

Compared to the $14.2 to $25.4 billion in offshore wind economic output (AWEA 2020), the 2019 annual GDP for states with offshore wind projects (Connecticut, Massachusetts, Rhode Island, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina) ranged from $63.5 billion in Rhode Island to $1.73 trillion in New York (U.S. BEA 2020) and totaled nearly $5 trillion. The $14.2 to $25.4 billion in offshore wind industry output would represent 0.3 to 0.5 percent of the combined GDP of these states.

The ACP study estimates offshore wind would support 45,500 (base scenario) to 82,500 (high scenario) full-time equivalent (FTE) jobs in the year 2030 nationwide, including direct, supply chain, and induced jobs. About 60 percent of jobs would be short term (i.e., design and construction) and 40 percent would be long term (i.e., operations). A 2020 study commissioned by the Responsible Offshore Development Alliance estimated that offshore wind projects through 2030 would generate 55,989 to 86,138 job years (an FTE job lasting 1 year) for construction, and 5,003 to 6,994 long-term jobs (an FTE lasting for more than 1 year) for operations (Georgetown Economic Services 2020). These estimates are generally consistent with the ACP study in total jobs supported, although the Georgetown Economic Services study concludes that a greater proportion of jobs would be in the construction stage. As with the ACP estimates of economic output, the Responsible Offshore Development Alliance study assumed that offshore wind energy jobs would be focused in states hosting offshore wind projects but would also be generated in other states where manufacturing and other supply chain activities occur.

Presently, over 500 domestic factories that employ more than 25,000 Americans build wind turbine components (AWEA 2021). U.S. companies have publicized investments of $307 million in port-related infrastructure, $650 million in transmission infrastructure, and $342 million in U.S. manufacturing and supply chain development, which can support the domestic supply chain growth (AWEA 2021).

Some local economic activity has already begun in preparation for the anticipated offshore wind industry. For example, MassCEC has implemented programs to train and certify a diverse set of workers to participate in the offshore wind industry (MassCEC 2022). MassCEC also released a workforce training and development report in 2021 that highlighted several (12) investments to support offshore wind workforce training (MassCEC 2021).

3.11.2 Environmental Consequences

Definitions of potential impact levels for demographics, employment, and economics are provided in Table 3.11-41.

Table 3.11-41: Impact Level Definitions for Demographics, Employment, and Economics

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

3.11.2.1 Impacts of Alternative A – No Action Alternative on Demographics, Employment, and Economics

When analyzing the impacts of Alternative A on demographics, employment, and economics, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the existing conditions for demographics, employment, and economics (Table G.1 8 in Appendix G, Impact Producing Factor Tables and Assessment of Resources with Minor [or Lower] Impacts). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for demographics, employment, and economics described in Section 3.11.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on demographics, employment, and economics include regional demographic and economic trends. While the proposed Project would not be built under Alternative A, ongoing activities, future non-offshore wind activities, and future offshore wind activities to continue to sustain and 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, especially Barnstable, Nantucket, Washington, and Dukes counties. Marine industries such as commercial fishing and shipping would continue to be active and important components of the regional economy. Counties in the geographic analysis area would continue to seek to diversify their economies, protect environmental resources, and maintain or increase their year-round population.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on demographics, employment, and economics include continued operation of the Block Island Wind Farm, as well as ongoing construction of Vineyard Wind 1 in OCS-A 0501 and the South Fork Wind Project in OCS-A 0517. Ongoing operation of the Block Island Wind Farm and ongoing construction of Vineyard Wind 1 and South Fork Wind Project, along with planned offshore wind activities, would affect demographics, employment, and economics through the primary IPFs described below.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than Alternative B). In addition to the regional economic impact of a growing offshore wind industry, future offshore wind development would affect demographics, employment, and economics through the following IPFs.

Cable emplacement and maintenance: Offshore cable emplacement for future offshore wind would temporarily impact commercial and for-hire fishing businesses based in the geographic analysis area during cable installation and infrequent maintenance. Offshore cable emplacement for offshore wind would result in about 9,314 acres of seafloor disturbance in the RI/MA Lease Areas from 2022 through 2030 (Appendix E). The total area of hard cable protection for Alternative A is estimated to be 1,315 acres. 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 fewer valuable species). Short-term productivity reductions would also affect seafood processing and wholesaling businesses that depend upon the fishing industry. Although cable routes and lengths for other offshore wind projects are not known at this time, the total seafloor disturbance from offshore cable emplacement is estimated to be 9,314 acres between 2022 and 2030, although only a portion of this total would be affected at any single time. Most affected areas are soft-bottom habitats, and impacts would be short term with the resources recovering naturally.

Assuming projects use installation procedures similar to those proposed for the proposed Project (COP Volume I, Sections 3.3 and 4.3; Epsilon 2022a), 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. Section 3.9, Commercial Fisheries and For-Hire Recreational Fishing, discusses the economic impact of cable emplacement and maintenance on fishing businesses. These impacts would be localized and short term.

Lighting: Based on COPs submitted to date, BOEM assumes that ADLS would be used for all offshore wind projects in the RI/MA Lease Areas. ADLS only activate aviation warning lighting on WTGs when aircraft enter a predefined airspace. For the proposed Project, this was estimated to occur approximately 13 minutes per year (less than 0.1 percent of annual nighttime hours) (COP Appendix III-H.b; Epsilon 2022a). Depending on exact location and layout, the use of ADLS for all WTGs in Alternative A 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 impacts on demographics, employment, and economics associated with lighting.

When illuminated due to a passing aircraft, warning lighting from some or all 903 WTGs constructed in the RI/MA Lease Areas (other than the proposed Project) could theoretically be visible within the geographic analysis area, depending on viewer location, vegetation, topography, and atmospheric conditions. This includes up to 52 (less than 5 percent of all WTGs in the RI/MA Lease Areas) within 15 miles of onshore viewers. Due to the rarity of such events, the variable views from onshore locations, and the relatively short-term nature of each event (i.e., lasting only as long as the aircraft is in range), lighting on WTGs would have an intermittent and short-term impact on demographics, employment, and economics.

Nighttime operations of offshore wind projects would require lighting for vessels in transit and at offshore construction work areas. Concurrent construction of up to six offshore wind projects (not including the proposed Project) could occur in 2025, 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 affect the volume of business at visitor-oriented businesses or other businesses. Impacts of vessel lighting would be localized, short term, and intermittent.

Noise: Noise from G&G site assessment survey activities, operations, pile driving, trenching, and vessels could result in 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 impacts on commercial and for-hire fishing. As discussed in Sections 3.6, Finfish, Invertebrates, and EFH, and Section 3.9, 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 impacts on employment and economic activity due to impacts 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 3.7, Marine Mammals, noise impacts associated with future offshore wind development could contribute to impacts on individual marine mammals. If construction activities for multiple offshore wind projects occur in close spatial and temporal proximity, population-level impacts are possible; however, as noted in Section 3.7, BMPs can minimize exposure of individual mammals to harmful impacts and avoid population-level impacts.

As noted in Section 3.6, noise from trenching and vessel operation is expected to occur but would have little effect on finfish and invertebrates and, therefore, little effect on commercial or for-hire fishing 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 and invertebrates (English et al. 2017).

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

Overall, offshore wind-generated noise could affect commercial and for-hire fishing and could result in visitor-oriented services avoiding areas of noise, and impacts on marine life important for fishing and sightseeing. 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. Pile-driving noise could be generated from up to six other offshore wind projects in the RI/MA Lease Areas (in 2025), which could result in greater noise impacts on finfish and invertebrates (Sections 3.6 and 3.9) and marine mammal (Section 3.7) species linked to economic activity. As indicated in Appendix E, Table E-1, the RI/MA Lease Areas could have 903 WTGs and ESPs installed between 2022 and 2030 (excluding the proposed Project).

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. The onshore construction noise activities from Phase 1 are not anticipated to overlap in location with other offshore wind projects. Impacts on demographics, employment, and economics from noise would be intermittent and short term, similar to other onshore utility construction activity.

Port utilization: Future offshore wind development would support use and expansion of ports and supporting industries in Rhode Island, Massachusetts, Connecticut, New York, and New Jersey. Section 3.11.1 lists ports identified as possibly supporting proposed Project construction. Section 3.13, Navigation and Vessel Traffic, and Section G.2.7, Land Use and Coastal Infrastructure, provide more detailed information about these ports. Projects constructed as part of Alternative A could also use these ports, as well as others along the Atlantic coast. Deepwater Wind has committed to improvements to ProvPort and the Port of Davisville to support the Revolution Wind Project (Kuffner 2018). Most other utilization or expansion of existing ports or development of new port facilities is intended to support the offshore wind industry as a whole and are not specifically tied to individual offshore wind projects.

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 to 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 in the RI/MA Lease Areas, which would be constructed between 2022 and 2030 (Appendix E, Table E-1). Ongoing maintenance and operational support would sustain port activity and employment at a lower-level once construction is complete.

The port investment and usage generated by offshore wind would have long-term, 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 beneficial impact of offshore wind operations services and improved port facilities would provide sustained long-term employment and economic activity. The most intensive beneficial impacts would occur during construction of offshore wind projects near the geographic analysis area between 2022 and 2030. The beneficial impact of offshore wind operations services and improved port facilities would provide sustained long-term employment and economic activity.

Port usage could potentially have short- to medium-term impacts on commercial shipping if offshore wind construction results in competition for limited berthing space and port services. The proposed Brayton Point site is a redevelopment site specifically for offshore wind and would, thus, accommodate offshore wind activity without competing with other marine interests. The MCT was built specifically to support offshore wind, and the ports of Davisville, ProvPort, and the Port of Albany are pursuing expansion suitable for offshore wind development support. Depending on the success of these planned expansions and the volume of activity at these and other ports outside the geographic analysis area, offshore wind development could result in increased competition and costs, as well as possible delays or displacement for current port users.

Presence of structures: Alternative A would include construction of up to 903 WTGs and ESPs, up to 7,169 acres of foundation and scour protection, and 1,315 acres of hard protection for cables (excluding the proposed Project). Commercial fishing operators, marine recreational businesses, and shore-based supporting services (such as seafood processing) could experience short-term impacts during construction. This could lead to higher costs and reduced income for commercial and for-hire recreational fishing businesses during construction, resulting from the need to adjust routes and fishing grounds to avoid offshore construction areas. Allisions could lead to vessel damage and spills, with direct costs (i.e., vessel repairs and spill cleanup), as well as indirect costs from damage caused by spills.

Commercial trawlers/dredgers would need to be aware of and avoid the locations of hard cable coverage (especially concrete mattresses) to avoid potential gear loss, damage, or entanglement. The impacts of hard cable protection on commercial fishing businesses would be long term 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 protection 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 impacts. 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. Up to six offshore wind projects in the RI/MA Lease Areas, excluding the proposed Project, could be under construction simultaneously in 2025. With advance communication and planning, races could be routed to avoid offshore wind construction areas or structures.

Recreational fishing targeting HMS such as tuna, shark, and marlin also generates business for charter fishing and visitor services providers. These businesses are likely to be affected by offshore wind structures because the HMS fisheries are more likely to overlap areas where offshore wind development would occur than other fisheries, which tend to occur closer to shore. While HMS angling has fewer participants and trips than 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 2019e).

Additionally, structures in the marine environment are known to attract certain marine species through the reef effect, which can lead to economic impacts and new opportunities for commercial or for-hire recreational fishing (Kularathna et al. 2019). The fish aggregation and reef impacts of up to 7,169 acres of hard protection around offshore wind structures would also provide new opportunities for recreational fishing. Aggregation and reef impacts would impact the minority of recreational fishing vessels that travel as far from shore as offshore wind structures (Section 3.9). 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. Businesses that would benefit from fish aggregation and reef effects—such as those that cater to HMS and offshore fishing recreationists—may grow. The attraction of anglers to offshore wind structures is not anticipated to result in a volume of new recreational fishing large enough to replace or displace commercial fishing businesses by recreational fishing businesses.

In summary, offshore wind structures and hard protection for cables would have 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 is anticipated to be able to adjust fishing practices over time in order to maintain the commercial fishing industry in the context of offshore wind structures (also see discussion of economic impacts on commercial and for-hire recreational fishing in Section 3.9). 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 impacts on certain businesses serving the recreation and tourism industry. Impacts could be adverse 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 3.16, Scenic and Visual Resources, portions of up to 903 WTGs (excluding the proposed Project) would theoretically be visible from beaches and coastal areas in the geographic analysis area for demographics, employment, and economics.

A joint research study of the University of Connecticut and Lawrence Berkeley National Laboratory found no net impacts from WTGs on property values in Massachusetts (Atkinson-Palombo and Hoen 2014). The study examined impacts of 41 onshore WTGs located 0.25 to 1 mile from residences. The study noted weak evidence linking the announcement of new WTGs to impacts on home prices and found that those impacts were no longer apparent after the start of WTG operations. The offshore wind structures would be different than those analyzed in that report in that offshore WTGs would be much larger than the onshore WTGs but located much further from residences and would appear small on the horizon (also see for additional discussion of visual impacts on vacation rental properties in Section 3.16).

Overall, the presence of offshore wind structures would have a continuous, long-term impact on employment and economics in commercial/for-hire fishing, marine recreation, coastal recreation, and tourism.

Traffic: Increased vessel traffic from construction, operations, and decommissioning of ongoing and planned activities, including offshore wind, would produce demand for supporting marine services, with beneficial impacts on employment and economics, particularly during construction. Construction, operations, and decommissioning of other offshore wind projects in the RI/MA Lease Areas would increase vessel traffic and demand for supporting marine services at ports throughout the geographic analysis area. Alternative A would also increase vessel congestion and safety risk near ports.

Other considerations: Once built, over the long term, future offshore wind could ensure reliability and enhance energy security by diversifying the regional energy supply, given that various power plants in the region have recently retired or are expected to retire in the coming years (COP Volume III, Section 4.1.1; Epsilon 2022a). 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 (compared to more than 21,000 MW currently provided by renewable sources in Massachusetts) from offshore wind development for Massachusetts and Rhode Island (U.S. Energy Information Administration 2019). 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 could be long term and beneficial. Future offshore wind activities would have similar contributions as Phase 1, but on a larger scale and over a larger geographic area.

Conclusions

Impacts of Alternative A. Under Alternative A, demographics, employment, and economics would continue to follow current regional trends and respond to current and future environmental and societal activities. While the proposed Project would not be built under Alternative A, ongoing activities related to the IPFs (continued commercial shipping and commercial fishing; ongoing port maintenance and upgrades; periodic channel dredging; maintenance of piers, pilings, seawalls, and buoys; and the use of small-scale, onshore renewable energy) would have **minor** impacts and **minor** beneficial impacts on demographics, employment, and economics.

Cumulative Impacts of Alternative A. Planned activities for coastal and marine activity other than offshore wind include development of diversified, small-scale, onshore renewable energy sources and peaker plants; ongoing onshore development at or near current rates; continued increases in the size of commercial vessels; potential port expansion and channel deepening activities; and efforts to protect against potential increased storm damage and sea level rise. The demographic, employment, and economic impacts of these planned activities other than offshore wind would be **minor** impacts and **minor** beneficial impacts, driven primarily by the continued operation of existing marine industries, especially commercial fishing, recreation/tourism, and shipping; increased pressure for environmental protection of coastal resources; the need for port maintenance and upgrades; and the risks of storm damage and sea level rise.

Regional offshore wind development other than the proposed Project is anticipated to generate increased investment within the geographic analysis area in ports, shipping, and logistics capability (both land and marine), component laydown and assembly facilities, job training, and other services and infrastructure necessary for offshore wind construction and operations. If U.S. supply chains develop as anticipated, additional manufacturing and servicing businesses would result, either in the geographic analysis area, or at other locations in the United States. While it is not possible to estimate the extent of job growth and economic output within the geographic analysis area, jobs and investment would result in notable and measurable benefits to employment, economic output, infrastructure improvements, and community services, especially job training, that would occur as a result of future offshore wind development. If the proposed Project is not built, the specific commitments included in the applicant's Host Community Agreement (HCA) with the Town of Barnstable (authorized October 21, 2021) would not be realized (COP Volume I, Section 4.1; Epsilon 2022a). However, other offshore wind projects in the RI/MA Lease Areas would enact similar commitments in the geographic analysis area.

Many of the jobs generated by offshore wind projects are temporary construction jobs. The combination of these jobs over multiple activities and projects would create notable benefits during construction of these projects. This would particularly be the case as the domestic supply chain for offshore wind evolves over time. Offshore wind projects also support long-term operations jobs (lasting up to 30 years); long-term tax revenues; long-term economic benefits of improved ports and associated industrial land areas; diversification of marine industries, especially in areas currently dominated by recreation and tourism; and growth in a skilled marine construction workforce.

Offshore wind construction and operations could disrupt the surrounding communities and ecosystems through disturbance of fish and marine mammal species and displacement of commercial or for-hire fishing vessels, potentially resulting in conflict over other fishing grounds, increased operating costs, and lower revenue for marine industries and supporting businesses. The long-term presence of offshore wind structures would also affect these marine industries due primarily to increased navigational constraints and risks, as well as potential gear entanglement and loss.

Considering all the IPFs together, the overall cumulative impacts of ongoing and planned activities in the geographic analysis area would result in **minor** and **moderate** beneficial impacts on demographics, employment, and economics.

3.11.2.2 Relevant Design Parameters and Potential Variances in Impacts

The following primary proposed Project design parameters (Appendix C, Project Design Envelope and Maximum-Case Scenario) would influence the magnitude of the impacts on demographics, employment, and economics:

- The number and position of WTGs installed;
- The extent to which the applicant hires local residents and obtains supplies and services from local vendors;
- The port(s) selected to support construction, installation, and decommissioning;
- The port(s) selected to support operations in addition to Vineyard Haven Harbor and the MCT; and
- The design parameters that could impact commercial fishing and recreation and tourism as impacts on these activities affect employment and economic activity.

3.11.2.3 Impacts of Alternative B – Proposed Action on Demographics, Employment, and Economics

This section identifies potential impacts of Alternative B on demographics, employment, and economics.

Impacts of Phase 1

Impacts include increased population and housing demand due to Phase 1 workforce needs; job creation; and the economic effects of tax revenues, payroll, and other expenditures; and other funds provided by the applicant in connection with Phase 1. Other impacts include economic activity generated within the geographic analysis area through spending and taxes paid by proposed Project employees or vendors; and spending by governments.

Economic impacts may occur in the recreation, tourism, and commercial fishing sectors as discussed below in the analysis of individual IPFs. Impacts on recreation and tourism (Section 3.15) could affect the economic health of businesses and individuals that serve tourists and seasonal residents. Impacts on commercial fisheries (Section 3.9) may in turn affect the economic health, as well as the cultural identity and values—and therefore the well-being—of individuals and communities that identify as “fishing” communities.

The beneficial impacts on employment and the economy under Phase 1 are highly dependent on assumptions regarding the percent of workers, materials, equipment, vessels, and services that can be locally sourced. The applicant’s economic impact study estimates that Phase 1 would directly support the following employment in Connecticut alone (COP Volume III, Section 7.1; Epsilon 2022a):

- Construction: Phase 1 would support approximately 770 direct FTEs in Connecticut during pre-construction, construction, and installation. Additionally, spending during this period is expected to result in the creation of 495 indirect and induced jobs.
- Operations: Phase 1 is expected to employ 70 FTEs annually, for a total of 2,100 job years (1 job year is the equivalent of one person working for 1 year) assuming a 30-year life. It is anticipated that 80 percent of these jobs would be based in Bridgeport, Connecticut. Phase 1 would create approximately 90 additional indirect and induced jobs annually (2,700 FTE jobs over 30 years). In total, Phase 1 is expected to support 160 annual direct, indirect, and induced FTE jobs (4,800 FTE job years) (COP Appendix III-L; Epsilon 2022a).
- While the COP does not provide information on decommissioning impacts, this analysis assumes that decommissioning of Phase 1 would likely have a similar composition and size of the workforce as construction of Phase 1 (COP Volume III, Section 7.1; Epsilon 2022a).

Jobs created would require workers from a variety of backgrounds with varying skill and educational levels, ranging from environmental scientists and engineers to ironworkers and machine operators. The applicant expects approximately 80 percent of the 770 direct FTE jobs during Phase 1 would be located in Connecticut (COP Appendix III-L, Section II; Epsilon 2022a). The estimated direct, indirect, and induced impacts of Phase 1 would result in $16.4 million in annual labor income and $17 million in annual expenditures during operations (COP Appendix III-L, Section III; Epsilon 2022a).

In addition to job creation, growth of local businesses, and tax revenues, the applicant has committed to providing the following economic benefits for Phase 1 (COP Volume III, Section 4.1; Epsilon 2022a):

- **Nantucket Offshore Wind Community Fund:** Contribution of $3 million at the financial close of Phase 1. Proceeds would support the Town and County of Nantucket, the Maria Mitchell Association, and the Nantucket Preservation Trust to support projects related to protecting and preserving cultural and historic resources, climate adaptation, coastal resiliency, and other initiatives.
- **HCA with Town of Barnstable**: Funding to the Town of Barnstable to offset potential impacts associated with onshore activities. The HCA for Phase 1 has not been executed but would likely be similar to the HCA approved in 2018 for Vineyard Wind 1 (Town of Barnstable 2018).

- **Supply Chain Network Initiative:** Investment of $9 million for "projects and initiatives to accelerate the development of the offshore wind supply chain and businesses" (COP Volume III, Section 7.1.2; Epsilon 2022a), focused in Connecticut. This includes up to $5 million for workforce education, training, and recruitment.
- Other economic and community benefits are listed in COP Volume III (Section 4.1; Epsilon 2022a) and in Appendix III-O (Epsilon 2022a).

Phase 1 would affect demographics, employment, and economics through the following primary IPFs during construction, operations, and decommissioning. Except where otherwise noted, the impacts of Phase 1 decommissioning for each IPF would be the same as for construction.

Cable emplacement and maintenance: Emplacement of Phase 1 offshore export, inter-array, and inter-link cables would disturb approximately 442 acres 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 and disrupt fish stocks near the installation locations. Cable emplacement would have larger impacts on fixed gear fisheries, which are highly territorial. It would be more difficult for fixed gear operators to adapt to removal of gear during cable installation. Therefore, in the context of reasonably foreseeable environmental trends, installation of Phase 1 cables would have localized, short-term, and **minor** impacts on employment and economics due to impacts on the commercial/for-hire fishing business.

The presence of up to 35 acres of hard cable protection would have larger impacts on fixed gear fisheries, which are highly territorial and would need to avoid hard protection areas. Therefore, Phase 1 would have localized, long-term, and **minor** impacts on demographics, employment, and economics, due to impacts on the commercial/for-hire fishing business.

Climate change: Phase 1 would result in a small reduction in or avoidance of emissions from power generation resulting in a long-term and **negligible** beneficial impact on demographics, employment, and economics.

Land disturbance: Phase 1 would require onshore cable installation and substation construction in Barnstable County. The disturbance of businesses near the Phase 1 onshore cable route and substation construction site would result in localized, short-term, and **minor** impacts on demographics, employment, and economics. Land disturbance during operations would be limited to infrequent unplanned repairs of underground cables. These activities would be similar in nature to the activities described for construction but would affect a more limited area, for a shorter amount of time. Therefore, Phase 1 operations would have short-term and **negligible** impacts on demographics, employment, and economics due to land disturbance.

Lighting: Nighttime construction of Phase 1 would require lighting for vessels in transit and at offshore construction work areas. Phase 1 vessel lighting is not anticipated to impact visitor-oriented businesses or other businesses; therefore, lighting from Phase 1 would have short-term and **negligible** impacts.

The permanent aviation safety lighting required for Phase 1 WTGs could be visible at night from beaches and coastal locations on Martha's Vineyard and Nantucket, possibly affecting employment and economics in these areas if the lighting discourages visits or vacation home rental or purchases in coastal locations where Phase 1 WTG lighting is visible. The applicant has committed to voluntarily implement ADLS, which would limit the frequency and duration of aviation safety lighting to less than 0.1 percent of annual nighttime hours. Nighttime operations would require lighting for occasional operational vessels in transit. This lighting would be similar to and indistinguishable from lighting employed on vessels already visible offshore at night. Overall, Phase 1 operational lighting is not anticipated to affect visitor-oriented businesses or other businesses and would, therefore, have a localized long-term, intermittent, and **negligible** impact on demographics, economics, and employment.

Noise: The contribution of Phase 1 to noise from G&G survey activities, operations, pile driving, trenching, and vessels would affect certain marine business activities associated with commercial/for-hire fishing, marine sightseeing, and recreational boating. These impacts would occur during the 2-year Phase 1 construction process, but impacts would be limited to active construction locations. As a result, Phase 1 would have intermittent, short-term, and **negligible** to **minor** impacts on visitors, workers, and residents from noise.

The impact of noise on demographics, employment, and economics during operations would be substantially less than the short-term noise created during construction (Mooney et al. 2020). Phase 1 would have **negligible** noise impacts.

Port utilization: Phase 1 construction would diversify jobs and revenues in the geographic analysis area's Ocean Economy sector. In particular, Phase 1 would enlarge and require new skills within the marine construction sector. It would also support demand for marine transportation and service workers for tug and other vessel charters, dockage, fueling, inspection/repairs, provisioning, and crew work (Borges et al. 2017a). These jobs within the Ocean Economy sector would be concentrated in Connecticut (reflecting the applicant's Phase 1 economic incentives in that state) but could also be created in states with other port facilities described in Section 3.11.1. Phase 1 could temporarily compete with the commercial fishing industry for marine workers and services during construction, potentially increasing labor and service costs and encouraging vessel owners to use services in ports not supporting offshore wind development. Compared to the overall GDP of Connecticut, Massachusetts, and other states where construction activities may occur, Phase 1 construction would have short-term and **minor** beneficial impacts on demographics, employment, and economics.

The applicant anticipates that the operations land-based facilities would use the Port of Bridgeport and an existing industrial marina facility in Vineyard Haven that provides marine vessel services and houses multiple businesses. Other ports could also be used for operations activities. As shown in Section 3.11.1, Fairfield County (Port of Bridgeport) has a concentration of manufacturing, construction, and professional jobs. Duke's County (Vineyard Haven Harbor) has a high proportion of seasonal housing, as well as an older population and higher proportion of employment in visitor services than the Massachusetts statewide average. The operations facility at the Port of Bridgeport would support the county's existing economic strengths, while the facility at Vineyard Haven would help to diversify the island's economy by providing a source of skilled, year-round jobs. Therefore, Phase 1 would have long-term and **minor** beneficial impacts on demographics, employment, and economics.

Presence of structures: Up to 63 foundations (including up to 2 ESPs, with the remainder for WTGs) constructed for Phase 1 could affect commercial and for-hire recreational fishing businesses during construction, resulting from the need to avoid new structures and hard protection for foundations and cables. Construction areas, increased vehicle traffic, and increased vessel traffic could affect businesses involved with shore-based supporting services and could result in increased costs and reduced income for all businesses dependent on the Ocean Economy. The impacts of Phase 1 construction on demographics, employment, and economics would be continuous, short term, and **minor** due to impacts on marine-based businesses.

As described in Section 3.16, portions of all Phase 1 WTGs could theoretically be visible from south-facing coastal areas and elevated locations on Martha's Vineyard and Nantucket. As discussed in Section 3.15, views of WTGs could have impacts on businesses serving the recreation and tourism industry. The presence of structures of Phase 1 could have both adverse and beneficial impacts on economics due to property value impacts and viewshed impacts on recreational and tourist businesses.

Considering the distance from shore and limited visibility of the offshore structures from coastlines, elevated locations, residences, and businesses, operation of Phase 1 would have **negligible** impacts on economics due to property value impacts and viewshed impacts on recreational and tourist businesses.

The 63 foundations, and approximately 109 acres of hard protection for Phase 1 WTG and ESP foundations and cable protection could affect commercial fisheries and for-hire recreational fishing due gear entanglement, damage, and loss, navigational hazards (risk of allisions and collisions), fish aggregation, habitat alteration, effort displacement, and space use conflicts (Section 3.9). Individual recreational fishing and sightseeing could experience similar impacts (Section 3.15, Recreation and Tourism). As a result, Phase 1 operations would have a long-term and **moderate** impact on demographics, employment, and economics due to impacts on commercial and for-hire recreational fishing, for-hire recreational boating, and associated businesses.

Traffic: Phase 1 would generate vessel traffic in ports described in Section 3.11.1 supporting proposed Project construction and would result in an average of 30 and a maximum of 60 vessels operating in the SWDA and OECC simultaneously (COP Appendix III-I; Epsilon 2022a). Increased vessel traffic would increase the use of port and marine businesses, including tug services, dockage, fueling, inspection/repairs, and provisioning. This would result in continuous, short-term, and **minor** beneficial impacts during construction. Phase 1 vessel traffic could also cause temporary, periodic congestion within and near ports, leading to potential delays and an increased risk for collisions between vessels, which would result in economic costs for vessel owners. As a result, Phase 1 vessel traffic would also have continuous, short-term, and **minor** impacts on demographics, employment, and economics during construction.

As described in Section 3.13, vessel traffic for Phase 1 operations would be substantially less than for construction. Operations traffic would be focused on the Port of Bridgeport and Vineyard Haven Harbor but could also use other ports described in Section 3.11.1. The vessel traffic generated by Phase 1 would result in **negligible** beneficial impacts during operations and **minor** beneficial impacts during decommissioning due to activities at ports. Similar to construction, vessel traffic associated with Phase 1 could also result in temporary, periodic congestion within and near ports and would have **negligible** to **minor** impacts during operations.

Other considerations: Phase 1 would marginally contribute to energy security and resiliency for the geographic analysis area, providing economic benefit through a stable supply of energy. Therefore, Phase 1 would have long-term, localized, and **minor** beneficial impacts on demographics, employment, and economics.

Impacts of Phase 2

The overall economic impacts of Phase 2 would be similar to those described for Phase 1 but would be larger due to the larger scale of Phase 2 (i.e., 1,200 to 1,500 MW of capacity installed for Phase 2, compared to 804 MW installed for Phase 1). The applicant has not prepared a detailed economic analysis for Phase 2. This EIS assumes that much of the economic activity for Phase 2 would likely be split between Massachusetts (the issuer of the PPA for Phase 2, the proposed location of all onshore Phase 2 facilities, and the location of several likely construction and operations ports) and Connecticut, where Phase 1 and Phase 2 operations activities would occur.

The applicant's economic impact study estimates that Phase 2 would directly support the following employment (COP Volume III, Section 7.1; Epsilon 2022a):

- Phase 2, construction: Phase 2 would support approximately 1,064 direct FTEs during pre-construction and construction. Additionally, spending during this period is expected to result in the creation of 678 indirect and induced jobs.
- Phase 2, operations and decommissioning: Phase 2 is expected to employ 101 FTEs annually, for a total of 3,030 job years (1 job year is the equivalent of one person working for 1 year) assuming a 30-year life. Indirect and direct impacts from Phase 2 are estimated to create 129 additional indirect and induced jobs annually, resulting in 3,870 FTE job years during operations.

Overall, Phase 2 would generate at least $234 million in direct labor income and $325 million in total direct expenditures (excluding payroll) (COP Appendix III-L, Section III; Epsilon 2022a). In addition to job creation, growth of local businesses, and tax revenues, the applicant has committed to providing the following economic benefits for Phase 2 (COP Volume III, Section 4.1; Epsilon 2022a):

- **Nantucket Offshore Wind Community Fund:** Contribution of $3 million at the financial close of Phase 2, supporting the same purposes as described for Phase 1.
- **HCA with Town of Barnstable**: Funding to the Town of Barnstable to offset potential impacts associated with onshore activities. The HCA for Phase 2 has not been executed but would likely be similar to the HCA developed for Phase 1, as well as the HCA approved in 2018 for Vineyard Wind 1 (Town of Barnstable 2018).
- Other economic and community benefits listed in COP Volume III (Section 4.1; Epsilon 2022a) and in Appendix III-O (Epsilon 2022a).

If the applicant includes the SCV as part of the final proposed Project design, some or all of the impacts on demographics, employment, and economics from the Phase 2 OECC through Muskeget Channel would not occur. BOEM will provide a more detailed analysis of the impacts of the SCV and the Phase 2 OECC on demographics, employment, and economics in a supplemental NEPA analysis.

Phase 2 would affect demographics, employment, and economics through the following primary IPFs during construction, operations, and decommissioning. Operations and decommissioning impacts from Phase 2 IPFs would be the same as or indistinguishable from Phase 1. Phase 2 would include more WTGs and ESPs and a greater area of hard protection for foundations and cables; however, these differences would not meaningfully change the impact determinations for the IPFs discussed for Phase 1. Other operations and decommissioning impacts for Phase 2 would be identical to Phase 1.

Cable emplacement and maintenance: Phase 2 would result in 732 acres of seafloor disturbance from offshore export, inter-array, and inter-link cable emplacement. The impact of cable emplacement on commercial and recreational fisheries, commercially important marine species, and recreational activities is expected to be the same as Phase 1. Therefore, Phase 2 would have short-term and **minor** impacts on demographics, employment, and economics. Impacts from the SCV would be similar to impacts discussed for Phase 1 from cable emplacement and maintenance but would occur in Bristol County, Massachusetts.

Land disturbance: The Phase 2 onshore facilities would be constructed in similar locations to Phase 1. Therefore, the impacts of Phase 2 land disturbance on demographics, employment, and economics would be similar to Phase 1: short term and **minor**. Land disturbance from SCV construction would be similar to impacts discussed for Phase 1, but impacts would occur in Bristol County, Massachusetts.

Lighting: Construction lighting for Phase 2 would be similar to that for Phase 1 but farther from shore and, thus, less visible. As a result, Phase 2 lighting would have short-term, intermittent, and **negligible**

impacts on demographics, employment, and economics. Impacts from the SCV would be similar to impacts discussed for Phase 1 from lighting but would occur in Bristol County, Massachusetts.

Noise: The construction noise impacts of Phase 2 would be similar to those described for Phase 1. Therefore, Phase 2 would have intermittent, short-term, and **negligible** to **minor** impacts on visitors, workers, and residents from noise. Impacts from the SCV would be similar to impacts discussed for Phase 1 from noise but would occur in Bristol County, Massachusetts.

Port utilization: Phase 2 (with or without the SCV) would use the same ports as Phase 1 and would, thus, have **minor** beneficial impacts on demographics, employment, and economics.

Presence of structures: Phase 2 would add up to 89 stationary structures to the SWDA during construction, as well as 253 acres of hard protection for foundations and cables. The impacts of constructing Phase 2 structures would be similar to those discussed for Phase 1. As a result, the presence of structures during Phase 2 construction would have short-term and **minor** impacts on demographics, employment, and economics due to impacts on marine-based businesses. Impacts from the SCV would be similar to impacts discussed for Phase 1 from presence of structures but would occur in Bristol County, Massachusetts.

Traffic: Phase 2 is anticipated to have the same level of vessel traffic as Phase 1 and would, thus, have similar impacts. As a result, Phase 2 would have continuous, short-term, and **minor** beneficial impacts on demographics, employment, and economics during construction due to increased Ocean Economy activity. Phase 2 could also have a continuous, short-term, and **minor** impact due to increased congestion and safety risks. Vessel traffic from SCV construction would be similar to impacts discussed for Phase 1, but impacts would occur in Bristol County, Massachusetts.

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-8 in Appendix G would contribute to impacts on demographics, employment, and economics through the primary IPFs of cable emplacement and maintenance, port utilization, the presence of structures, and traffic. Other offshore wind projects would each have land disturbance impacts, but these impacts would be unlikely to occur in the same geographic area or timeframe as Alternative B and are, thus, not considered as cumulative impacts. Cumulative impacts would primarily occur through increased investment within the geographic analysis area in ports, shipping, and logistics capability (both land and marine), component laydown and assembly facilities, job training, and other services and infrastructure necessary for offshore wind construction and operations.

Up to seven offshore wind projects in the RI/MA Lease Areas (including the proposed Project) could be under construction simultaneously in 2025. The construction of offshore wind structures and hard protection from ongoing and planned activities would have short-term and **minor** to **moderate** impacts on commercial fishing operations and support businesses such as seafood processing. However ongoing and planned activities would result in **minor** and **moderate** beneficial cumulative impacts. However, ongoing and planned activities would result in **minor** and **moderate** beneficial impacts.

Conclusions

Impacts of Alternative B. Alternative B would have **minor** beneficial impacts on employment and economics due to job creation, expenditures on local businesses, tax revenue and grant funds provided by the applicant, and the support for additional regional offshore wind development that would result from construction of Alternative B. Construction would provide jobs and revenue but, considering the short duration of the construction period, would have a **minor** beneficial impact on employment and economics. Employment and expenditures during operations would be long term, lasting 25 to 30 years, but would be of modest magnitude, limiting the beneficial impact. Tax revenues and grant funds likewise would be modest in magnitude (compared to overall host-state GDP) but would provide a beneficial impact for public expenditures and development of the local job force and supply chain for offshore wind. Decommissioning of Alternative B would also have **minor** beneficial impacts on employment and economics due to the construction activity necessary to remove the wind facility structures and equipment. Upon completion of decommissioning, the jobs and economic activity generated by operations would cease and Alternative B would no longer produce employment and other revenues.

The IPFs associated with Alternative B would result in impacts on commercial/for-hire fishing businesses that range from **negligible** to **moderate**. Impacts on individual and community well-being in fishing communities are anticipated to be directly correlated to the level of impact anticipated on the commercial fishing industry. These impacts would be concentrated in communities identified as having medium to high commercial fishing engagement and reliance. Impacts on commercial fishing during construction would impact not only the commercial fishing industry itself, but also the onshore businesses that depend upon the local seafood supply, including seafood markets and processing. Overall, Alternative B would have **moderate** impacts on employment and economic activity in the commercial fishing and onshore seafood sectors. Although commercial fishing is a small component of the regional economy, it is important to the economy and identity of local communities within the region.

The IPFs associated with Alternative B would also result in impacts on certain recreation and tourism businesses that range from **negligible** to **moderate**. As noted in Section 3.15, construction and operation of Alternative B may have **minor** to **moderate** impacts on recreation and tourism in the geographic analysis area. Overall, these impacts on recreation and tourism would have **minor** impacts on employment and economic activity for this component of the geographic analysis area's economy.

Cumulative Impacts of Alternative B. The cumulative impacts on demographics, employment, and economics in the geographic analysis area would be **negligible** to **moderate** and **negligible** to **moderate** beneficial. Considering all the IPFs together, the overall impacts associated with ongoing and planned activities, including Alternative B, would result in **minor** impacts and **moderate** beneficial impacts on demographics, employment, and economics in the geographic analysis area. The primary factors for the beneficial impact ratings include impacts associated with investment in offshore wind, job creation and workforce development, and port utilization. The primary factors for adverse impacts include cable emplacement and maintenance, the presence of structures, vessel traffic, and land disturbance. Alternative B would contribute to the overall impact rating primarily through impacts from vessel traffic, the presence of structures (WTGs and ESPs), and new hiring and economic activity. **Moderate** impacts are anticipated due to impacts on commercial and for-hire recreational fishing (Section 3.9), but these impacts would only be a component of the overall impacts on this resource.

Thus, the overall adverse impacts 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. In addition, ongoing and planned activities, including Alternative B, would have **moderate** beneficial impacts on demographics, employment, and economics due to a notable and measurable benefit from construction- and operations-stage employment and economic improvement.

3.11.2.4 Impacts of Alternative C – Habitat Impact Minimization Alternative on Demographics, Employment, and Economics

Alternatives C-1 and C-2 would not affect the number or placement of WTGs or ESPs for the proposed Project compared to Alternative B. While Alternatives C-1 and C-2 would alter the exact routes of inter-array, inter-link, and export cables installed for the proposed Project—and could, thus, affect the exact length of cable installed and area of ocean floor disturbed—these changes would not result in meaningfully different impacts on demographics, employment, and economics compared to Alternative B. Therefore, the impacts of Alternatives C-1 and C-2 on demographics, employment, and economics would be the same as those of Alternative B.

3.12 Environmental Justice

3.12.1 Description of the Affected Environment

3.12.1.1 Geographic Analysis Area

This section discusses the existing conditions in the geographic analysis area for environmental justice, as described in Table D-1 in Appendix D, Geographical Analysis Areas, and shown on Figure 3.12-1. Specifically, this includes the counties where proposed offshore infrastructure is located, counties in closest proximity to the SWDA, and counties containing one of the 19 potential ports used for proposed Project construction, operations, or decommissioning (Table 3.12-1): Barnstable, Bristol, Dukes, Nantucket, and Essex counties, Massachusetts; Providence and Washington counties, Rhode Island; Fairfield and New London counties, Connecticut; Kings, Richmond, Rensselaer, Albany, and Suffolk counties, New York; and Gloucester County, New Jersey.

Table 3.12-1: Port Facilities by County

County	Potential Port Usage, Construction, Operations, and Decommissioning (Site Type)[a]
Bristol County, Massachusetts	Port of New Bedford (E) Brayton Point Commerce Center (P) Fall River terminal facilities (P)
Dukes County, Massachusetts	Vineyard Haven Harbor (E)
Essex County, Massachusetts	Salem Offshore Wind Port (P)
Fairfield County, Connecticut	Port of Bridgeport (E)
New London County, Connecticut	New London State Pier (E)
Gloucester County, New Jersey	Paulsboro Marine Terminal (E)
Albany County, New York	New York State Offshore Wind Port (P) Port of Coeymans (E)
Kings County, New York	GMD Shipyard (E) South Brooklyn Marine Terminal (E)
Rensselear County, New York	New York State Offshore Wind Port (P)
Richmond County, New York	Homeport Pier (P) Arthur Kill Terminal (P)
Suffolk County, New York	Shoreham site (P) Greenport Harbor (E)[b]
Providence County, Rhode Island	ProvPort (E) South Quay Terminal (G)
Washington County, Rhode Island	Port of Davisville (E)

Source: COP Volume III; Epsilon 2022a

ProvPort = Port of Providence
[a] Site types include the following:
E: This includes existing ports of industrial terminals that may be expanded to serve the offshore wind industry.
P: This includes industrial facilities proposed for redevelopment to serve offshore wind activities, regardless of the status of the proposed Project.
G: This includes Greenfield sites that have not been previously developed.
[b] This site is for operations only.

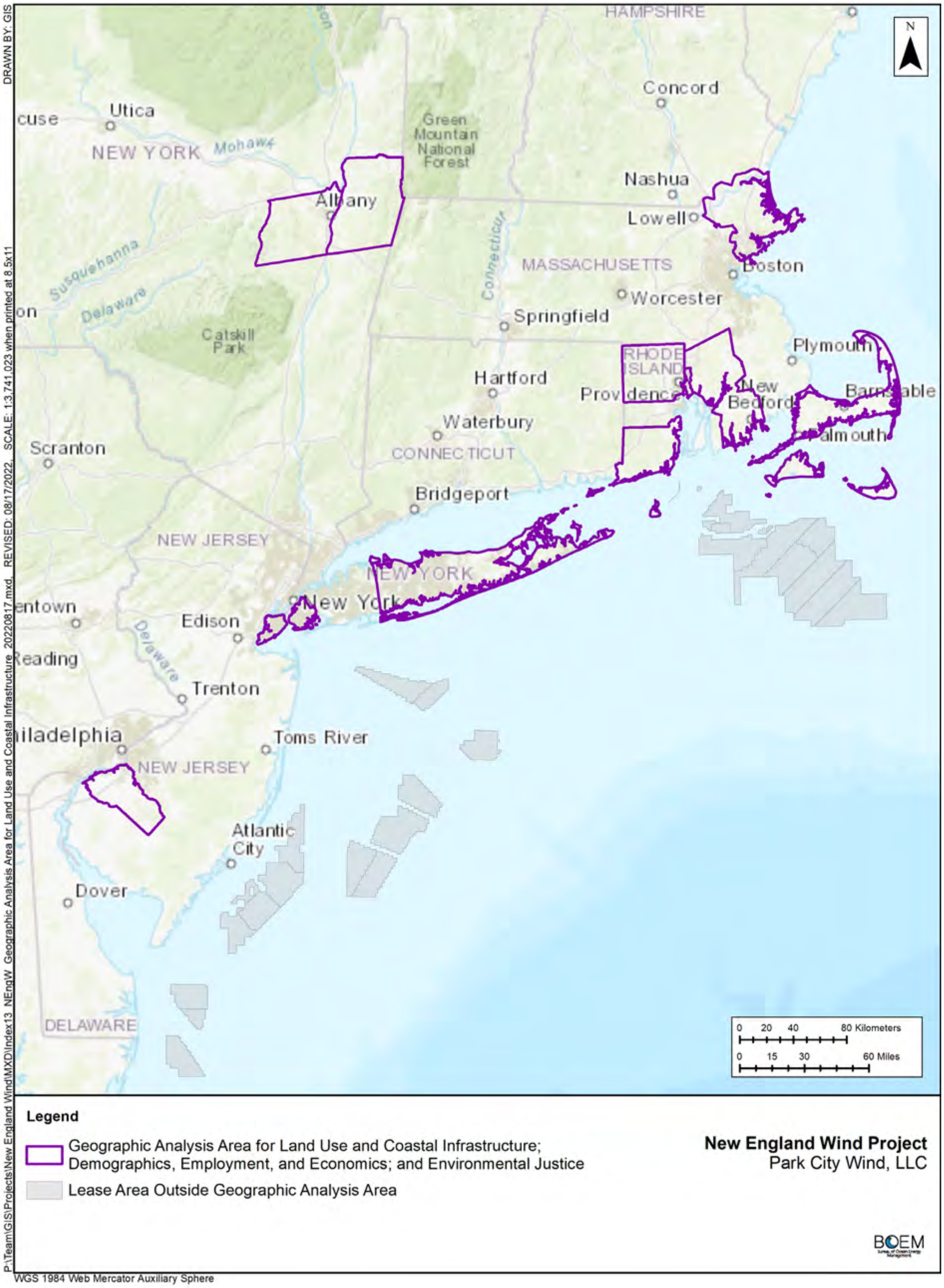


Figure 3.12-1: Geographic Analysis Area for Environmental Justice

3.12.1.2 Background

As described by the U.S. Environmental Protection Agency (USEPA), environmental justice is "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or policies" (USEPA 2021b).

Environmental justice impacts are characterized for each IPF as negligible, minor, moderate, or major using the four-level classification scheme outlined in Section 3.3, Definition of Impact Levels. A determination of whether impacts are "disproportionately high and adverse" in accordance with EO 12898 is provided in the conclusion section for each alternative.

EO 12898, Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations, requires that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (EO 12898). Potential environmental justice impacts are identified by determining whether there is or would be an impact on the natural or physical environment that disproportionately and adversely affects a minority population, low-income population or Native American tribe, including ecological, cultural, human health, economic, or social impacts; and whether the impacts appreciably exceed those on the general population or other appropriate comparison group (CEQ 1997). Beneficial impacts are not environmental justice impacts; however, this section identifies beneficial impacts on environmental justice communities, where appropriate.

EO 12898 directs federal agencies to consider the following issues with respect to environmental justice as part of the NEPA process (CEQ 1997):

- The racial and economic composition of affected communities;
- Health-related issues that may amplify project impacts on minority or low-income individuals; and
- Public participation strategies, including community or tribal participation in federal and state public engagement processes.

The USEPA states that environmental justice analyses must address disproportionately high and adverse impacts on minority populations (defined as individuals who are non-White, or who are White and have Hispanic ethnicity) when minority populations represent more than 50 percent of the population of an affected area, or when the percentage of minority or low-income populations in the affected area is "meaningfully greater" than the minority percentage in the "reference population." USEPA defines reference population as the population of a larger area in which the affected population resides (i.e., a county, state, or region, depending on the geographic extent of the analysis area). Low-income populations are those that fall within the annual statistical poverty thresholds from the U.S. Census Bureau's Population Reports, Series P-60 on Income and Poverty (USEPA 2016). In addition to federal environmental justice guidance, 13 states have independently codified their own laws for addressing environmental justice (Bruce 2021), including 5 in the geographic analysis area: Massachusetts, Rhode Island, Connecticut, New Jersey, and New York. All of these states contain ports that the proposed Project may use.

Analysis of environmental justice populations in this section relies primarily on data from the U.S. Census Bureau, as well as the USEPA's EJSCREEN tool. In addition, environmental justice populations in each state reflect state data tailored to each particular state's environmental justice assessment criteria, which can be more rigorous than federal criteria. Discussions of Massachusetts' and other state environmental justice policies and communities are provided below. Figures 3.12-2 through 3.12-15 show communities within the geographic analysis area that meet state or federal environmental justice criteria. These include communities near the ports that could potentially be used for proposed Project construction, operations, or decommissioning.

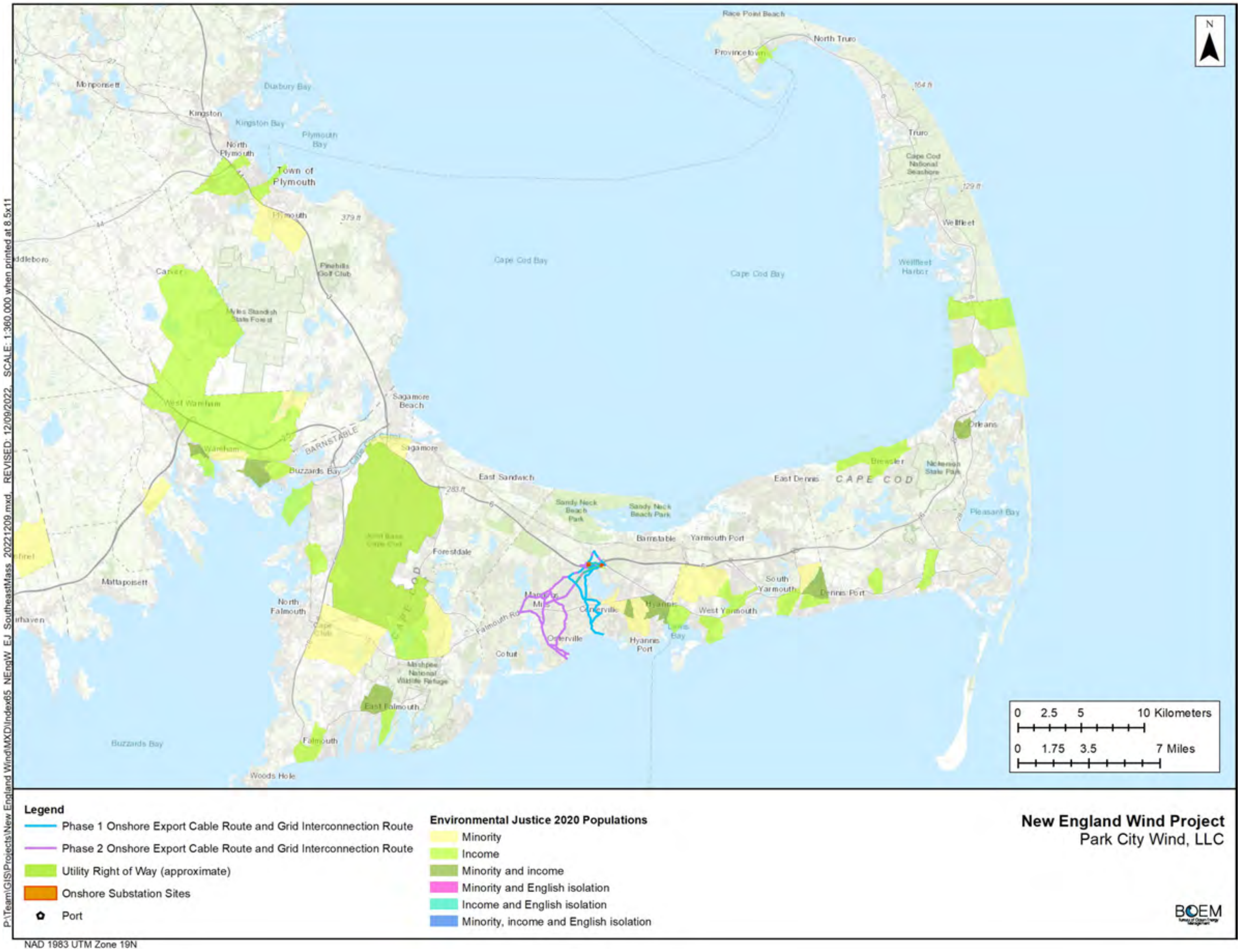
3.12.1.3 Massachusetts

Massachusetts Senate Bill (SB) 9 "creates a next-generation roadmap for the state's climate policy. This establishes new goals for reducing emissions and increases environmental justice protections by requiring environmental impact reports for projects that impact air quality and are located near certain communities" (Commonwealth of Massachusetts 2021b). Massachusetts identifies an environmental justice community as U.S. Census block groups that meet one of more of the following criteria (EEA 2021a):

- The annual median household income is no more than 65 percent of the statewide annual median household income;
- Minorities comprise 40 percent or more of the population;
- Twenty-five percent or more of the households lack English language proficiency, also known as English isolation;
- Minorities comprise 25 percent or more of the population, and the annual median household income of the municipality in which the neighborhood is located does not exceed 150 percent of the statewide annual median household income; or
- Is a geographic portion of a neighborhood designated by the Massachusetts Secretary of Energy and Environmental Affairs as an environmental justice population in accordance with law.

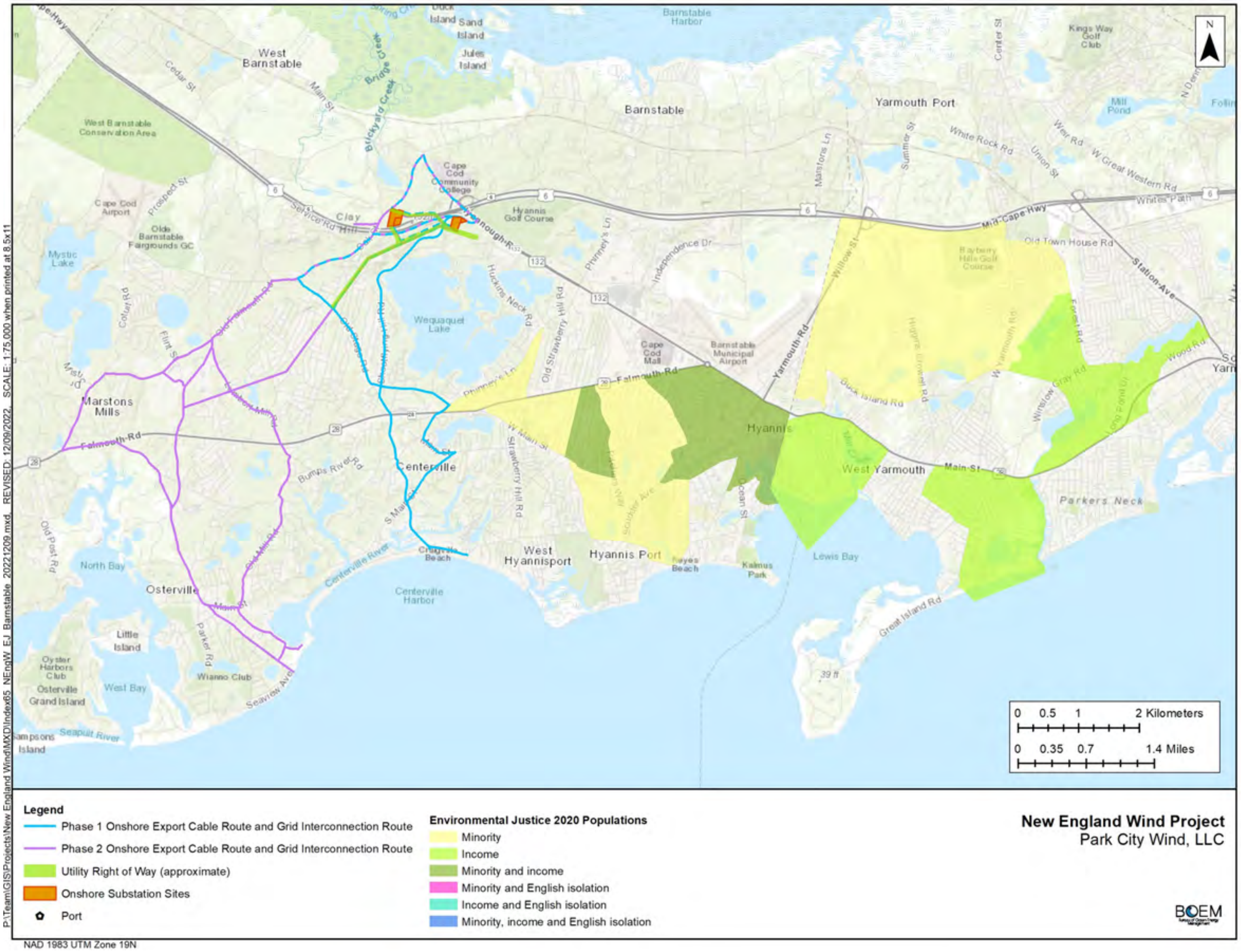
The term English isolation refers to a household that meets U.S. Census criteria for "linguistic isolation," specifically households where no one over the age of 14 speaks only English or English very well (EEA 2021a).

Environmental justice communities in the Massachusetts portion of the geographic analysis area (primarily census block groups that meet criteria for income and/or minority status) are clustered around larger cities and towns near the potential cable landing sites and potential ports in Hyannis, Salem, Somerset (Brayton Point), and New Bedford (the MCT). 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 (Native American) population is present near Aquinnah. Additional environmental justice communities occur on Cape Cod and are scattered throughout southeastern Massachusetts (EEA 2021b).



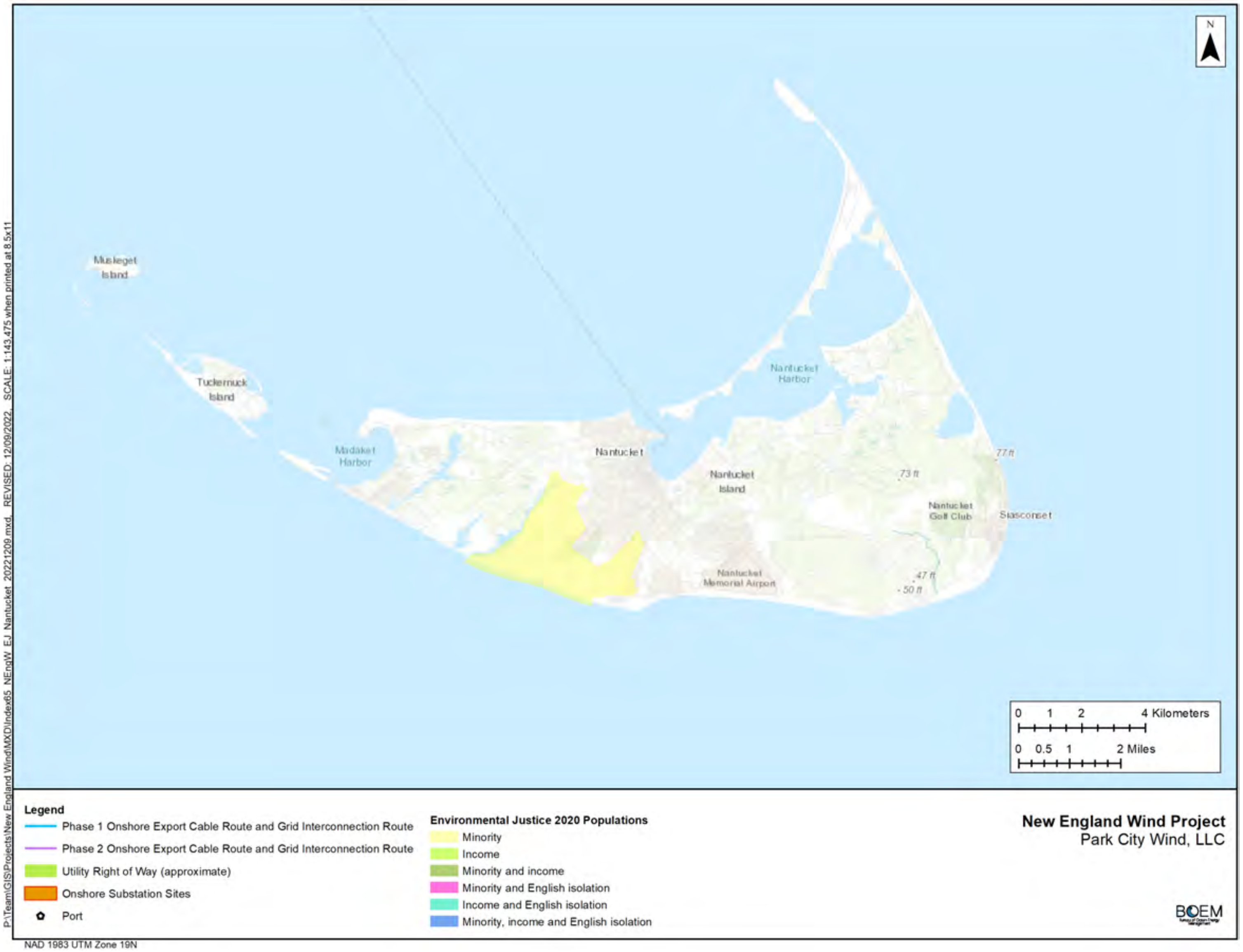
Source: Commonwealth of Massachusetts 2022

Figure 3.12-2: Environmental Justice Communities in Southeast Massachusetts



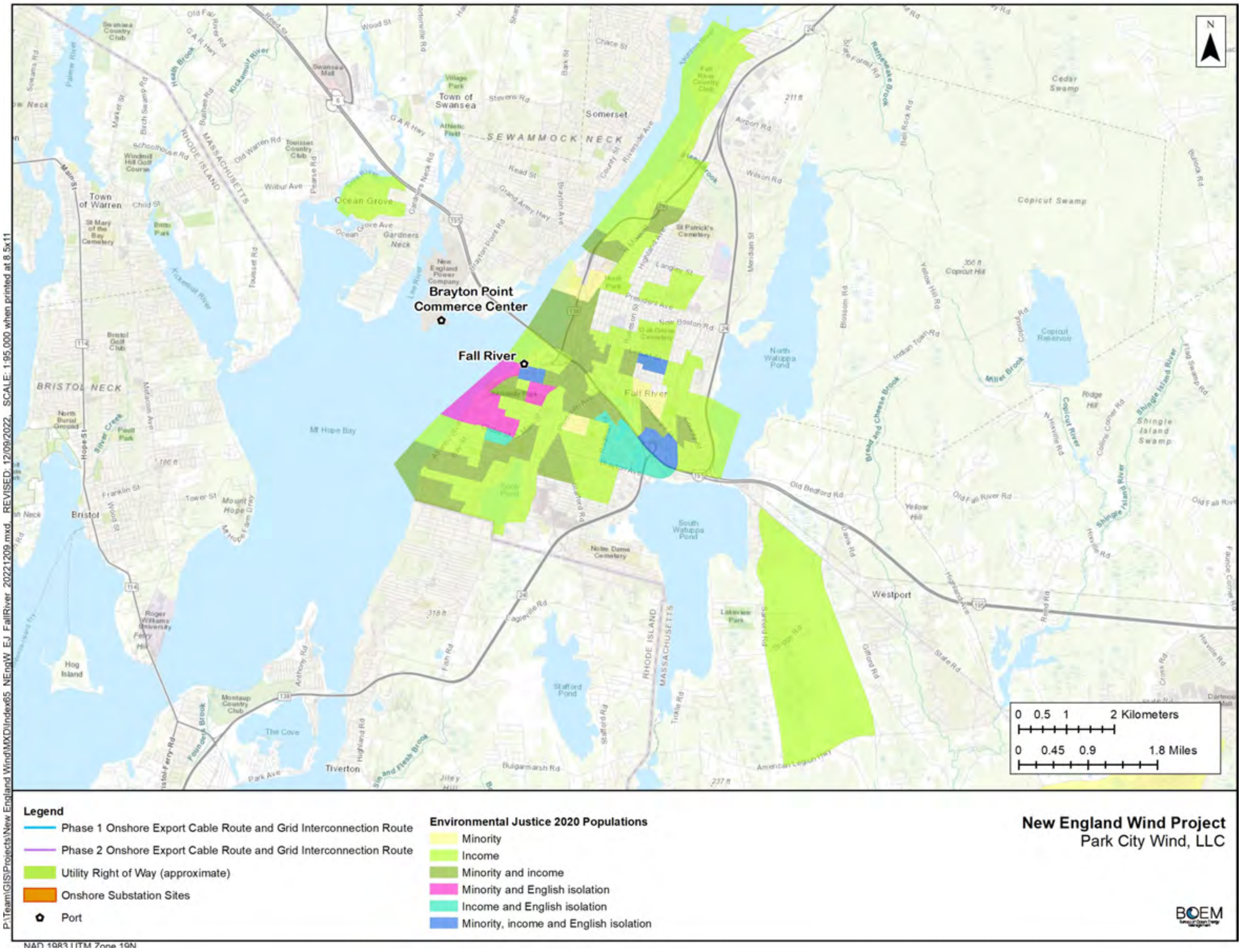
Source: Commonwealth of Massachusetts 2022

Figure 3.12-3: Environmental Justice Communities near Barnstable, Massachusetts



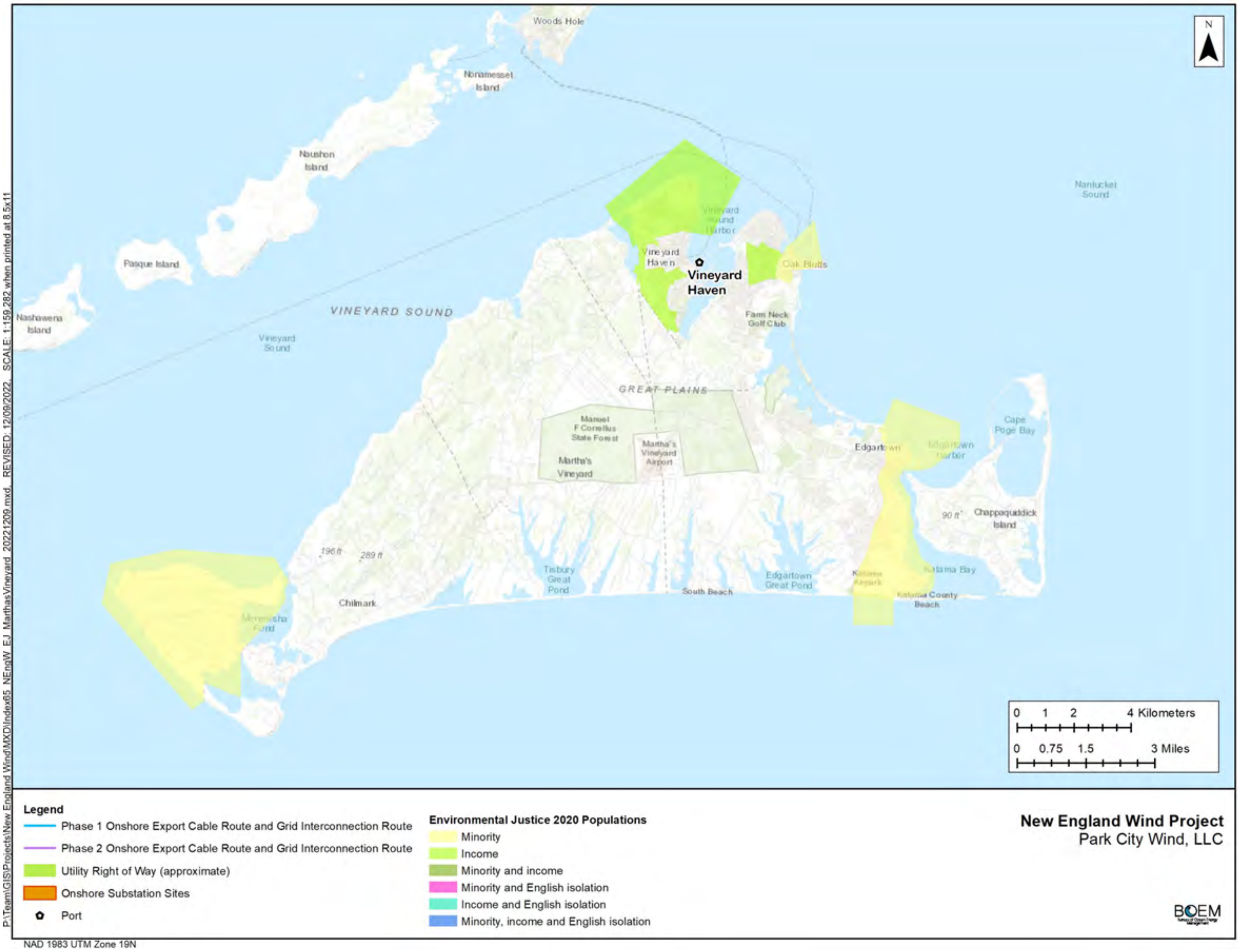
Source: Commonwealth of Massachusetts 2022

Figure 3.12-4: Environmental Justice Communities on Nantucket, Massachusetts



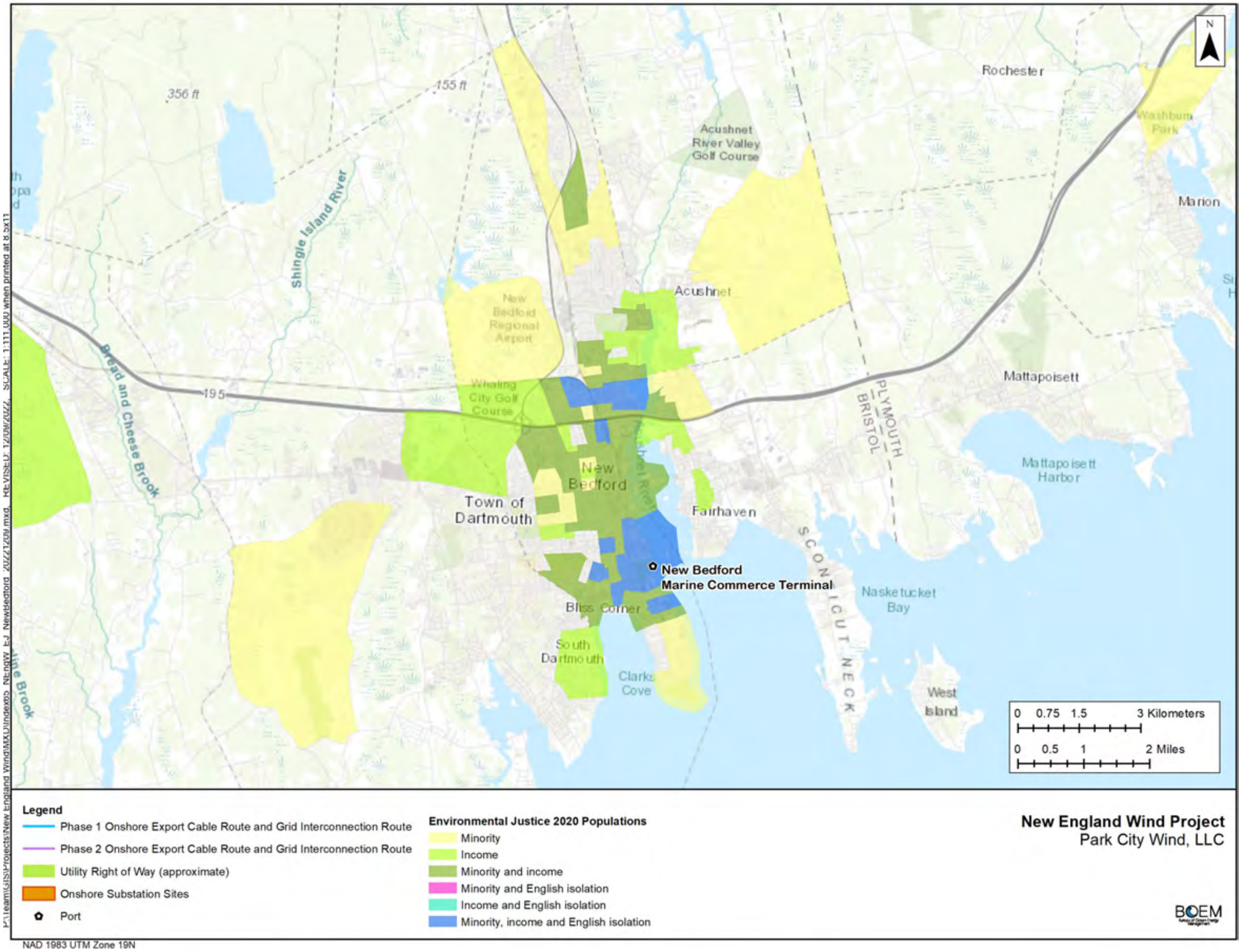
Source: Commonwealth of Massachusetts 2022

Figure 3.12-5: Environmental Justice Communities on Martha's Vineyard, Massachusetts



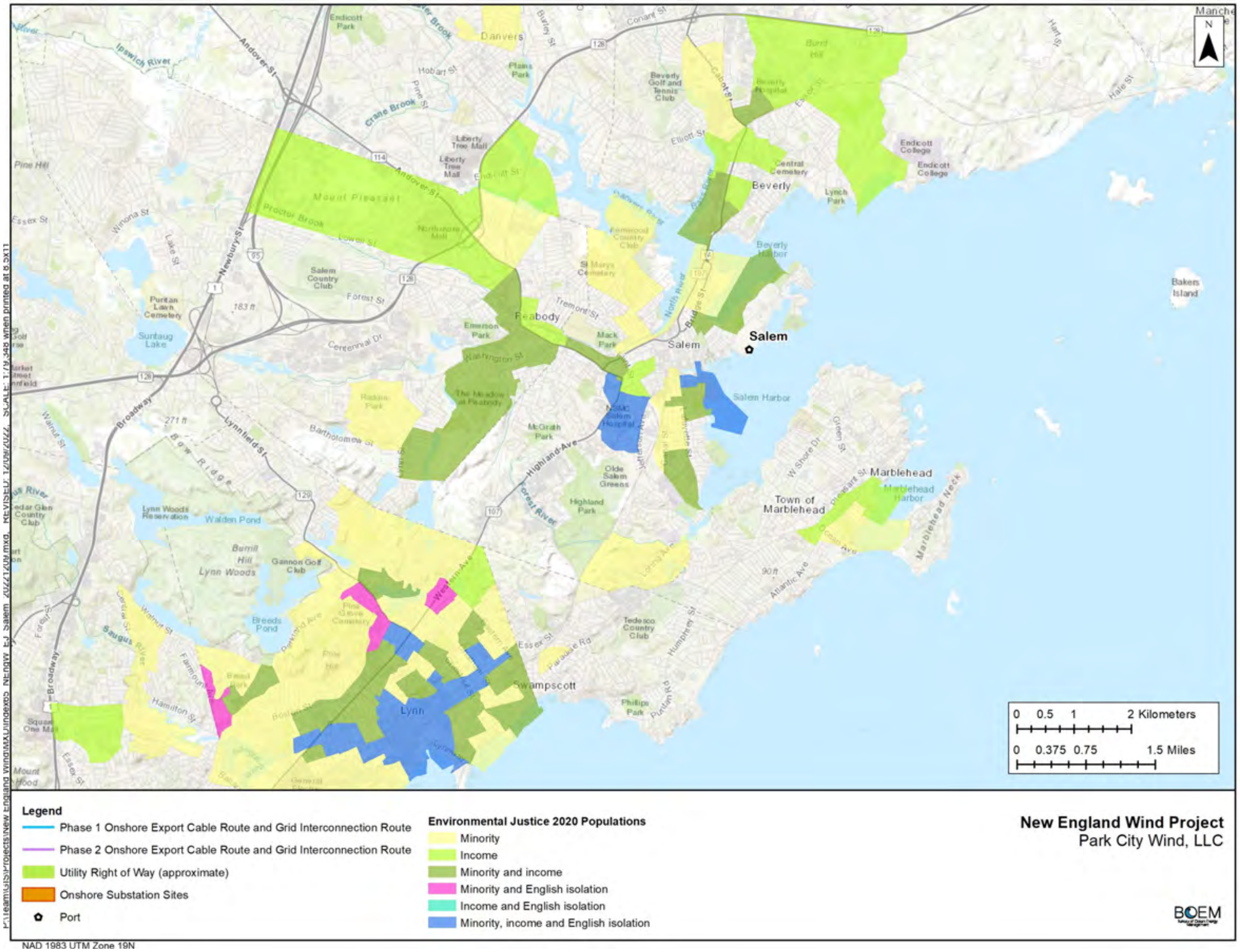
Source: Commonwealth of Massachusetts 2022

Figure 3.12-6: Environmental Justice Communities near Fall River, Massachusetts



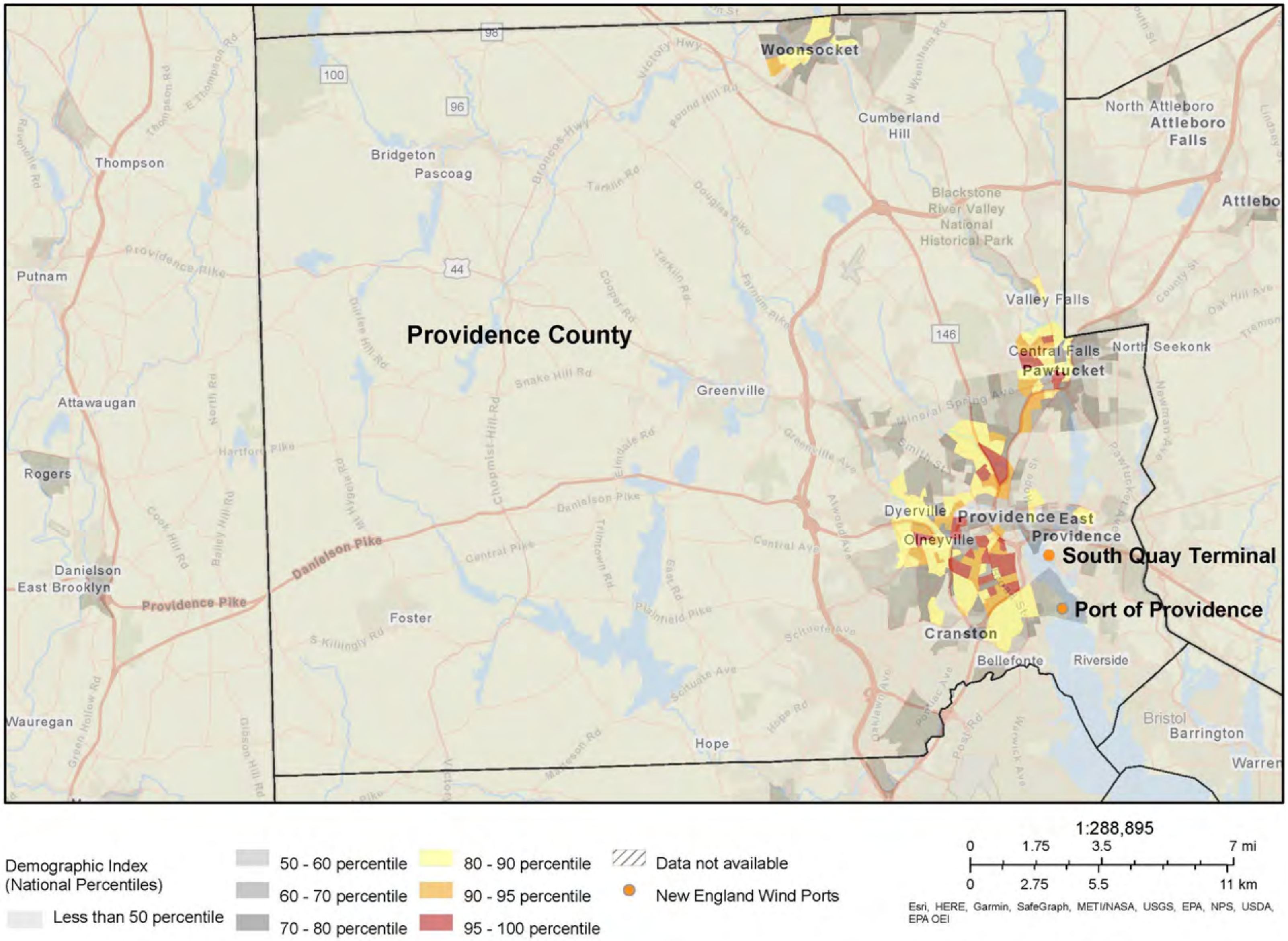
Source: Commonwealth of Massachusetts 2022

Figure 3.12-7: Environmental Justice Communities near New Bedford, Massachusetts



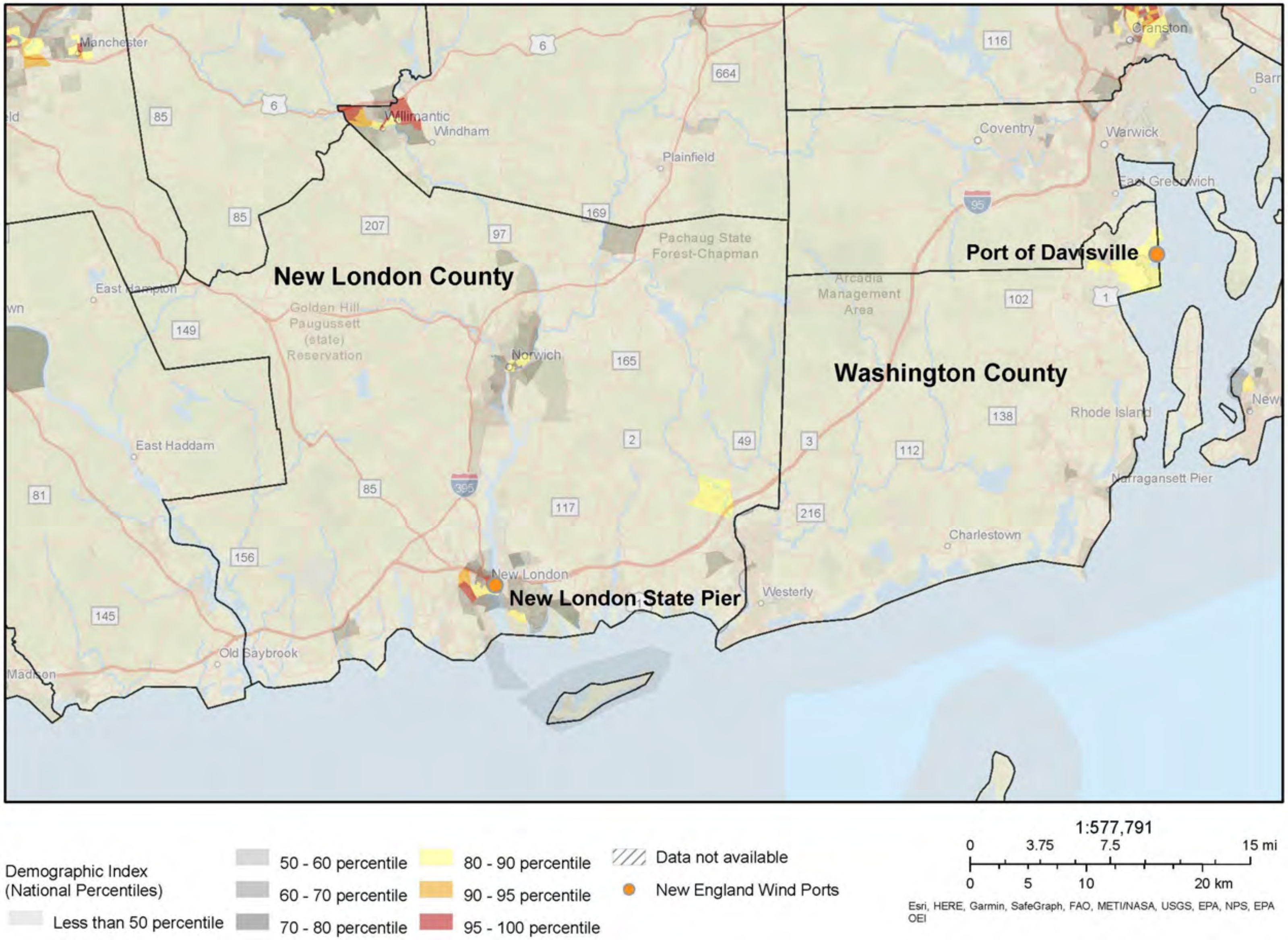
Source: Commonwealth of Massachusetts 2022

Figure 3.12-8: Environmental Justice Communities near Salem, Massachusetts



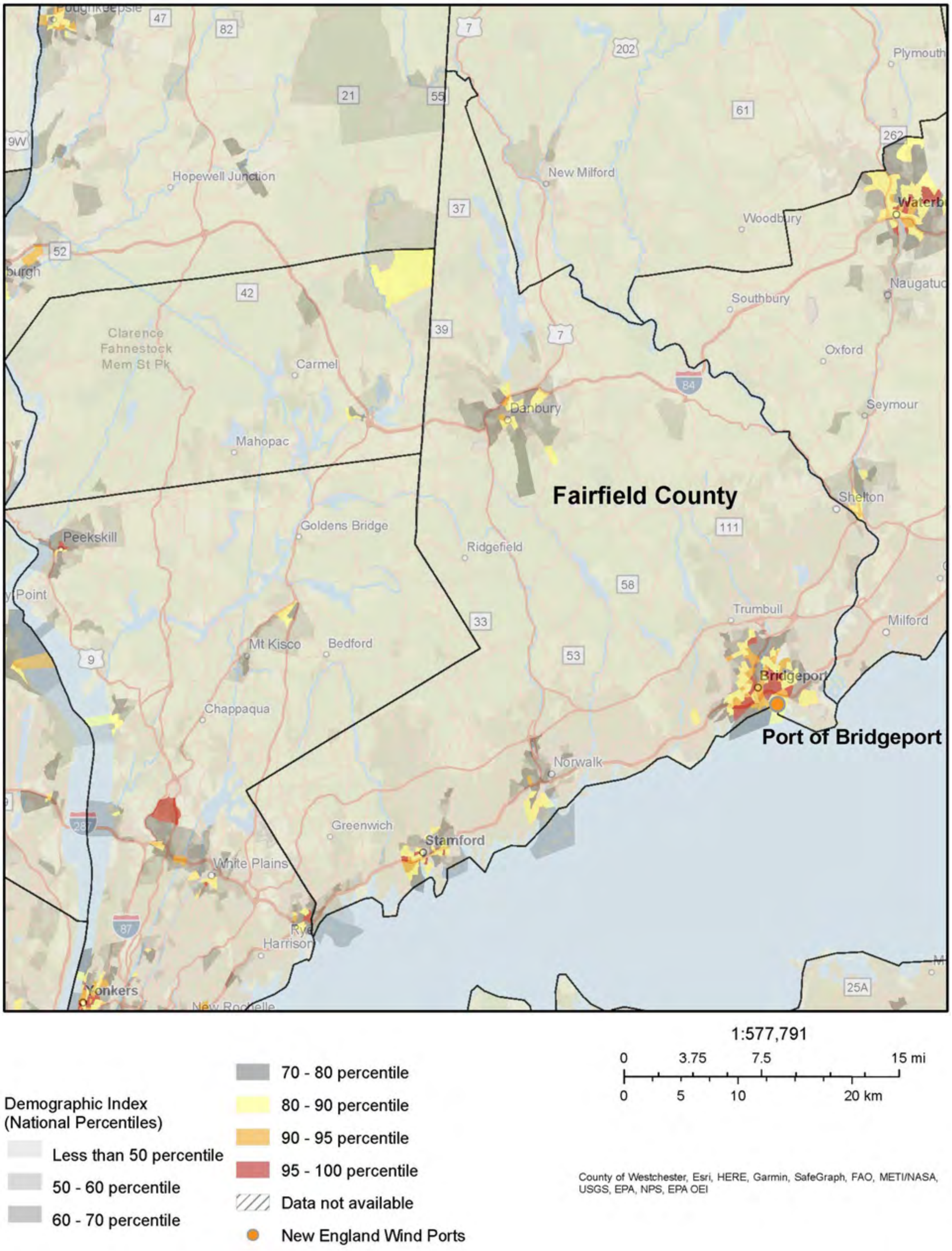
Source: USEPA 2022

Figure 3.12-9: Environmental Justice Communities in Providence County, Rhode Island



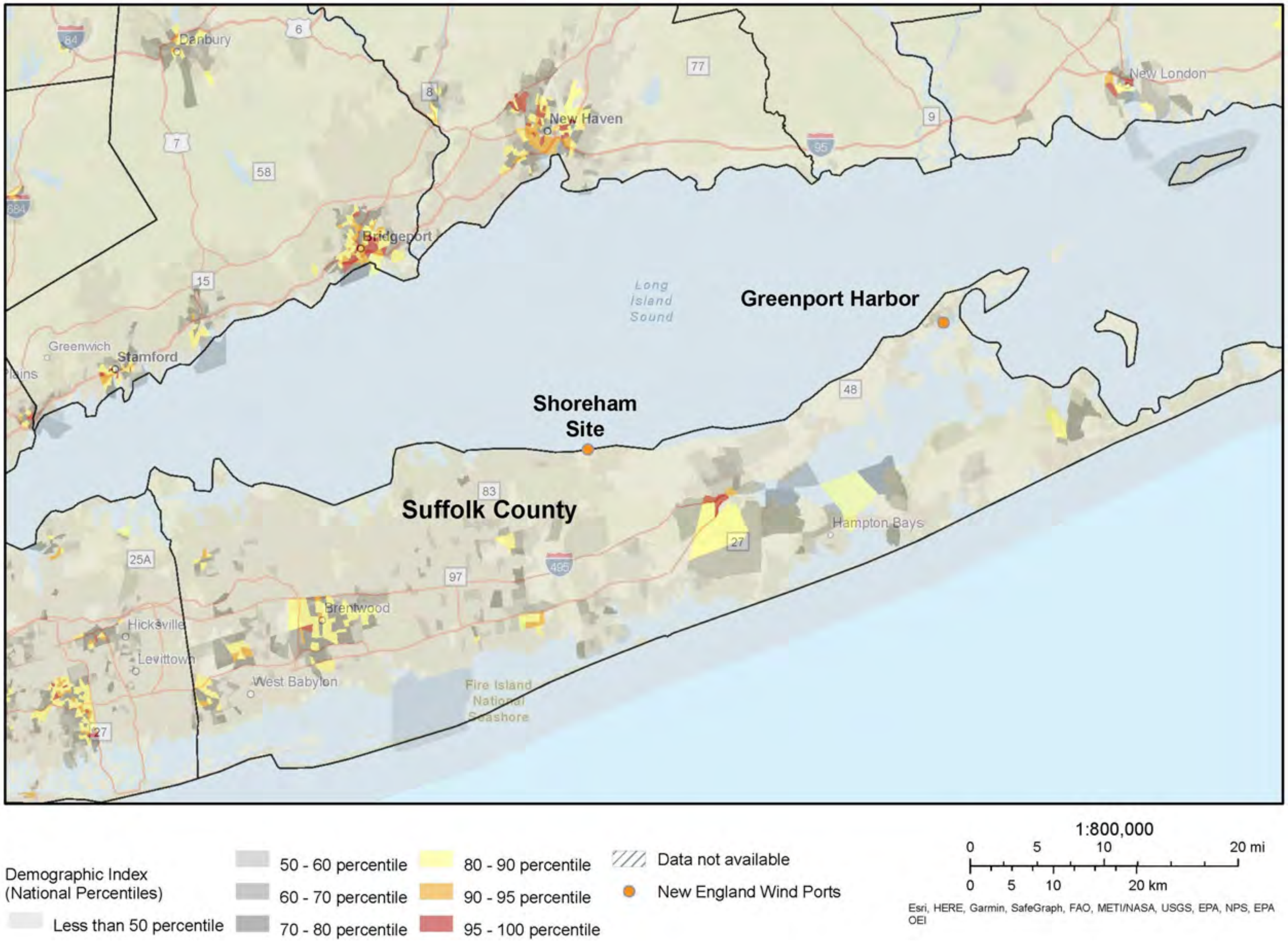
Source: USEPA 2022

Figure 3.12-10: Environmental Justice Communities in Washington County, Rhode Island, and New London County, Connecticut



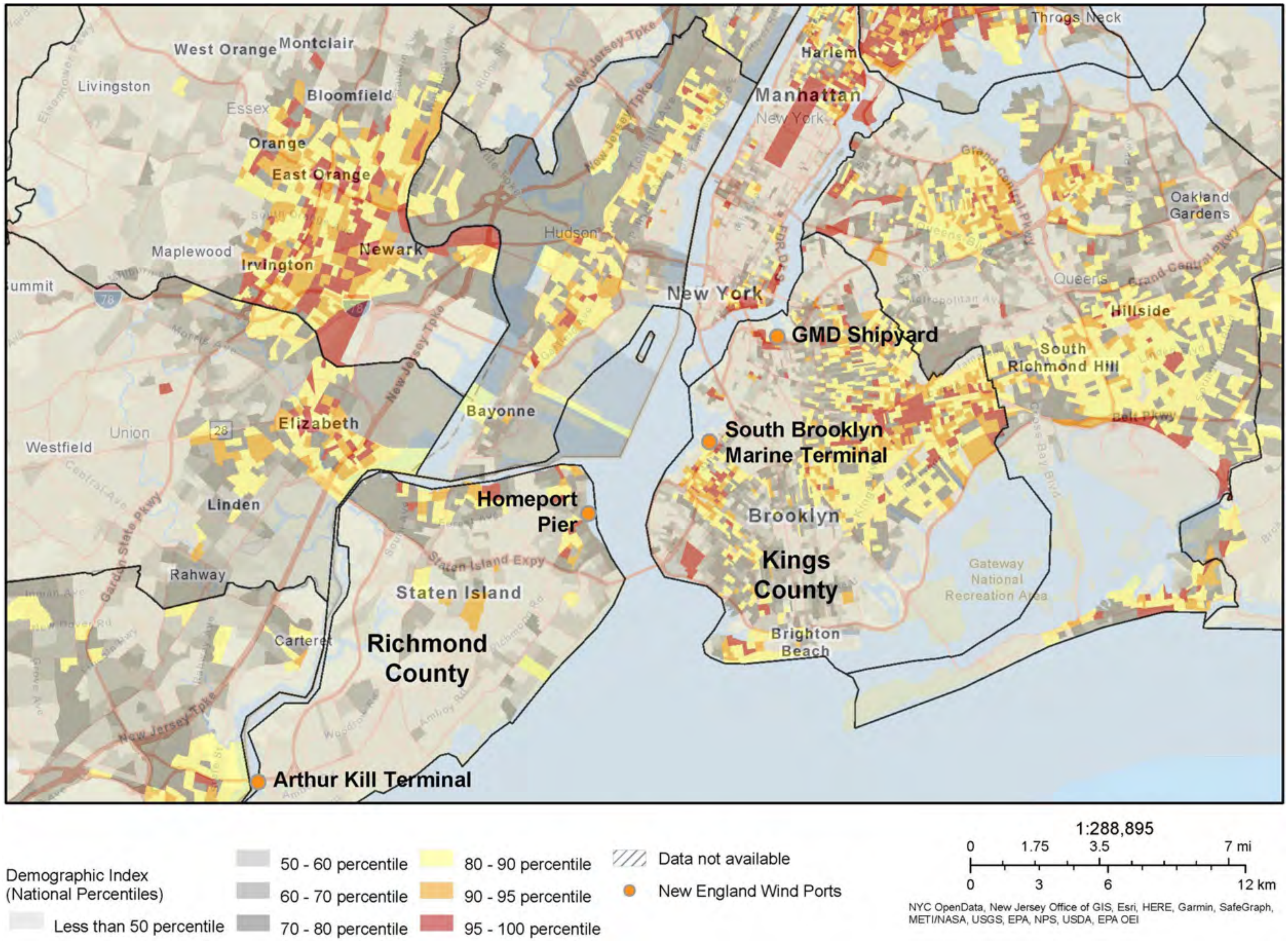
Source: USEPA 2022

Figure 3.12-11: Environmental Justice Communities in Fairfield County, Connecticut



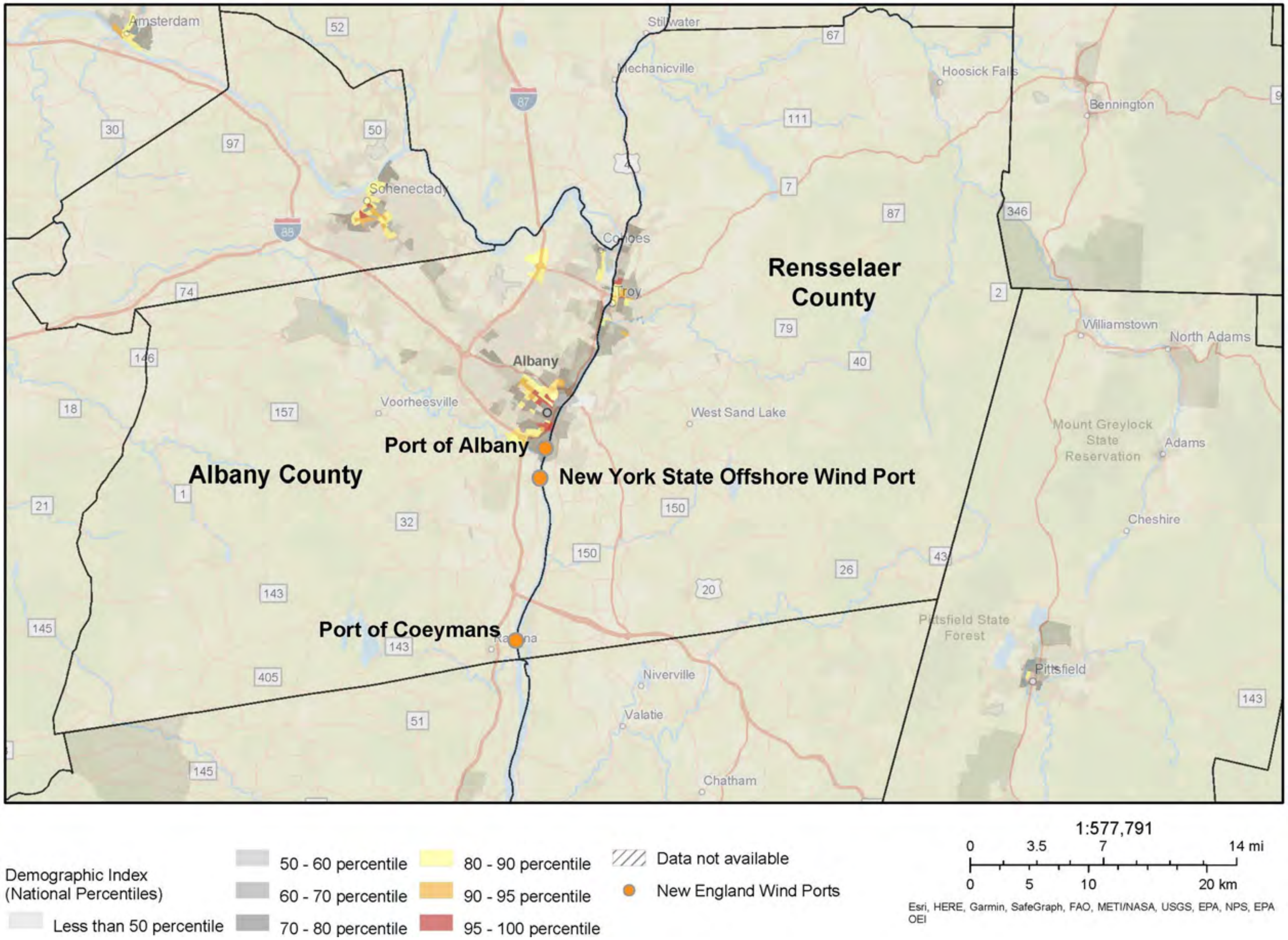
Source: USEPA 2022

Figure 3.12-12: Environmental Justice Communities in Suffolk County, New York



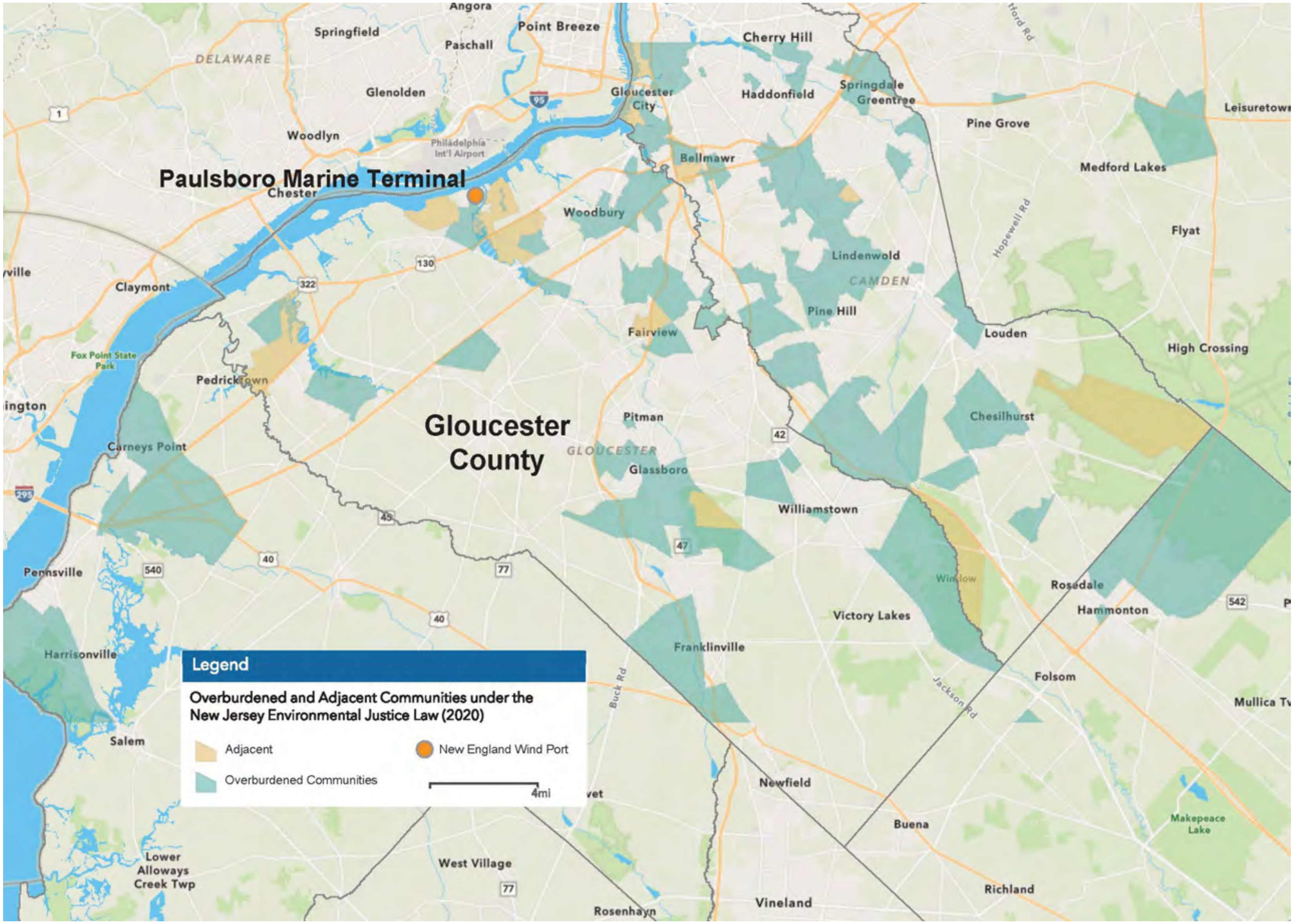
Source: USEPA 2022

Figure 3.12-13: Environmental Justice Communities in Richmond and Kings Counties, New York



Source: USEPA 2022

Figure 3.12-14: Environmental Justice Communities in Albany and Rensselaer Counties, New York



Source: NJDEP 2022

Figure 3.12-15: Environmental Justice Communities in Gloucester County, New Jersey

3.12.1.4 Rhode Island

Rhode Island SB 78 requires “an equitable transition to net-zero emissions and directs state agencies to address recommendations to protect populations most at risk of pollution, displacement, and energy burden” (State of Rhode Island 2021). Rhode Island’s Department of Environmental Management uses these same environmental justice quantifiers as the federal government but references minority and low-income status to state data. Any census block group with a minority or low-income population percentage that ranks in the top 15 percent of census block groups statewide is considered an environmental justice area of focus. Environmental justice communities meeting income criteria are present within and near ProvPort and Quonset Point (Davisville), while ProvPort also meets minority criteria. The South Quay Terminal is across the Providence River from (but within 1 mile of) the environmental justice communities near ProvPort.

3.12.1.5 Connecticut

Public Act 20-6, An Act Concerning Enhancement to State’s Environmental Justice Law of Connecticut, states that an environmental justice community is defined as a “census block group, as determined in accordance with the most recent U.S. Census, for which [30 percent] or more of the population consists of low-income persons who are not institutionalized and have an income below two hundred percent of the federal poverty level” (State of Connecticut 2020). Environmental justice communities meeting minority and income criteria in the Connecticut portion of the geographic analysis area are found near all three port facilities: Barnum Landing and Seaview Avenue on Bridgeport Harbor in Bridgeport and New London State Pier in New London.

3.12.1.6 New York

New York identifies environmental justice communities based on the following criteria (NYDEC 2003):

- Low-income community: a census block group, or contiguous area with multiple census block groups, having a low-income population equal to or greater than 23.59 percent of the total population.
- Low-income population: a population with an annual income that is less than the poverty threshold established by the U.S. Census Bureau.
- Minority community: a census block group, or contiguous areas with multiple census block groups, having a minority population equal to or greater than 51.1 percent of the total population in an urban area and 33.8 percent of the total population in a rural area.
- Minority population: means a population that is identified or recognized by the U.S. Census Bureau as Hispanic, African-American or Black, Asian and Pacific Islander, or Native American.

The New York City ports (GMD Shipyard, South Brooklyn Marine Terminal, Homeport Pier, and the proposed Arthur Kill Terminal) are all in or within 1 mile of communities that meet environmental justice criteria for minority status and income. The Port of Albany and New York Offshore Wind Port are within 1 mile of a portion of the City of Albany that meets minority and income criteria (although the ports themselves are not within those communities).

3.12.1.7 New Jersey

New Jersey SB 232 requires the New Jersey Department of Environmental Protection to “identify the state’s overburdened communities and imposes new requirements on permits for certain facilities located within the same census tract as these communities, including facilities that are major sources of air pollution, incinerators, sludge processing facilities, sewage treatment plants, and landfills” (State of New

Jersey 2020). In New Jersey, the term “overburdened” community is synonymous with the term “environmental justice community,” and refers to a location where:

- At least 35 percent of the households qualify as low-income households (at or below twice the poverty threshold as determined by the U.S. Census Bureau);
- At least 40 percent of the residents identify as minority or as a member of a state-recognized tribal community; or
- At least 40 percent of the households have limited English proficiency (based on U.S. Census definitions).

A community that meets environmental justice criteria for income is adjacent to the Paulsboro port site.

3.12.1.8 Other Communities

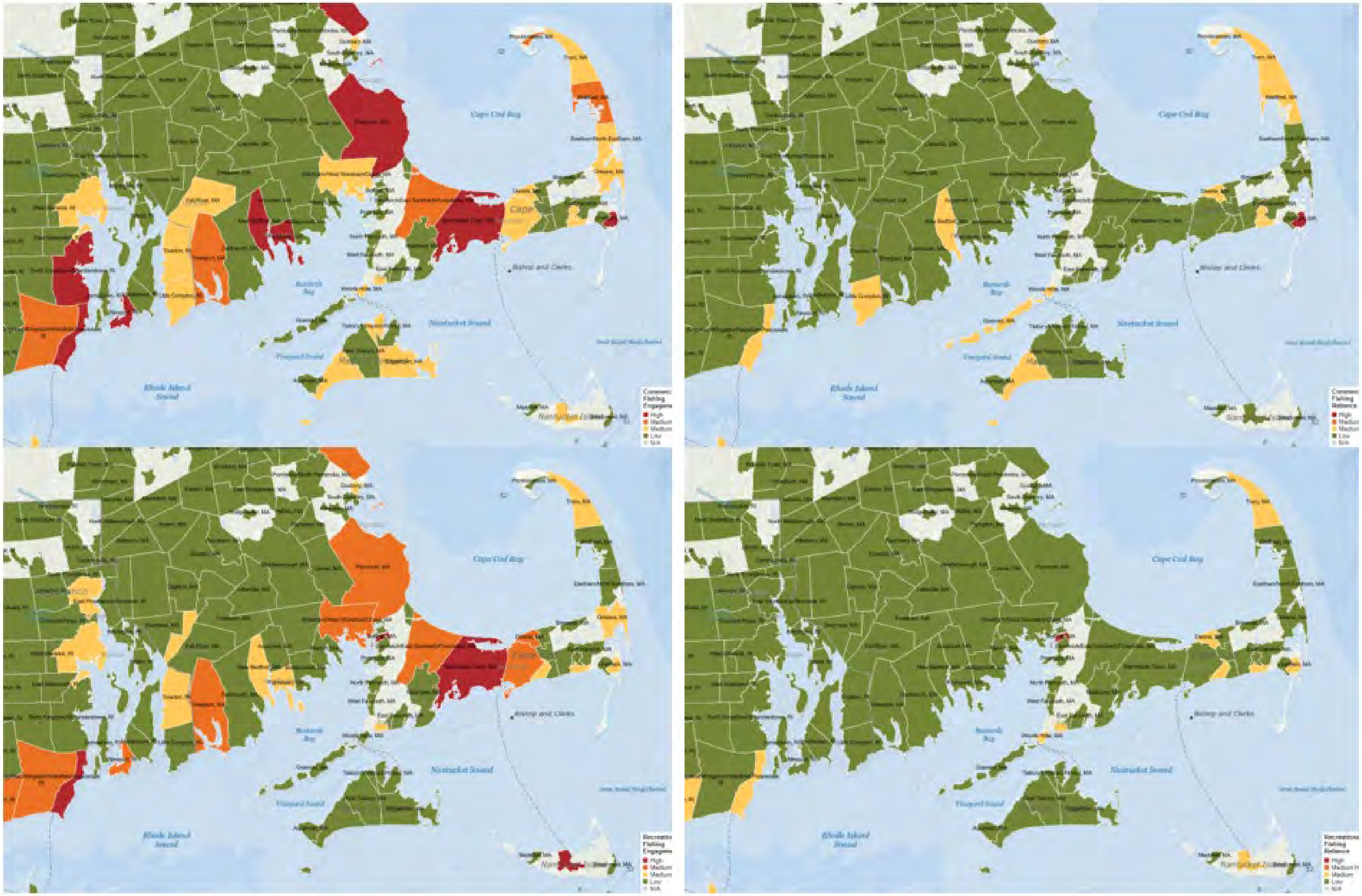
In addition to the geographic locations of environmental justice communities, low-income workers are found within the commercial fishing industry, service industries that support tourism, and other supporting industries. Ongoing development supports employment and economic development that may benefit some lower income workers, as discussed in Section 3.11, Demographics, Employment, and Economics. Offshore projects would provide continuing support for employment in the “ocean economy” sector, including, but not limited to, marine trades, vessel and port maintenance, and related industries.

Fishing industries generally provided higher wages and income than the tourist and recreation components of the ocean economy (Borges et al. 2017b). Commercial fishing is within the “living resource” sector of NOAA’s Coastal Economy index, which also includes seafood processing, seafood markets, aquaculture, and fish hatcheries. Other low-income and minority workers may be employed in commercial fishing and supporting industries that provide employment on commercial fishing vessels, at seafood processing and distribution facilities, and in trades related to vessel and port maintenance, or operation of marinas, boat yards, and marine equipment suppliers and retailers. As discussed in Section 3.11, average wages for living resource sector employees were higher than the county average for all workers in Barnstable, Bristol, Dukes, Essex, and Nantucket counties in Massachusetts. Living resource wages were also higher than the average wage in Washington and Providence counties in Rhode Island, as well as all the counties in New York and New Jersey (Section 3.11).

The average wage obscures the range of income levels, which include higher income workers (ship’s captains and managers), as well as lower-level or unskilled workers who earn substantially less than the average wage, including some self-employed individuals. Many lower-level workers in the living resource sector likely qualify as low-income and would, thus, be vulnerable to disruptions to employment in the commercial fishing industry.

NOAA’s social indicator mapping (Figure 3.12-16) identifies environmental justice populations in the geographic analysis area that also have a high level of fishing engagement or fishing reliance. The fishing engagement and reliance indices portray the importance or level of dependence on commercial or recreational fishing of coastal communities. Engagement measures the presence of commercial or recreational fishing through fishing activity, as shown through permits, fish dealers, and vessel landings. Reliance measures the presence of commercial or recreational fishing in relation to the population size of a community through community fishing activity (NOAA 2022g).

The Town of Barnstable, Massachusetts, would house physical components of the proposed Project. Barnstable has a high level of both commercial and recreational fishing engagement but low levels of both commercial and recreational fishing reliance. Environmental justice communities in Barnstable meet state and federal criteria for minority populations alone, low-income populations alone, and both minority and low-income populations (NOAA 2022g).



Source: NOAA 2022g

Figure 3.12-16: National Oceanic and Atmospheric Administration Social Indicator Mapping, Southeast Massachusetts and Vicinity

The Port of Bridgeport, Connecticut would be the base for proposed Project operations activities, including vessel traffic. Bridgeport has low levels of engagement and reliance for both commercial and recreational fishing (NOAA 2022g).

NOAA has also developed social indicator mapping related to gentrification pressure (NOAA 2022g). The gentrification pressure indicators measure factors that, over time, may indicate a threat to the viability of a commercial or recreational working waterfront. Gentrification indicators are related to housing disruption, retiree migration, and urban sprawl and are detailed as follows:

- Housing disruption represents factors that indicate a fluctuating housing market where some displacement may occur due to rising home values and rents including changes in mortgage values. A high rank means more vulnerability for those in need of affordable housing and a population more vulnerable to gentrification.
- Retiree migration characterizes communities with a higher concentration of retirees and elderly people in the population including households with inhabitants over 65 years, population receiving social security or retirement income, and level of participation in the work force. A high rank indicates a working waterfront population that is more vulnerable to gentrification due to retirees seeking the amenities of coastal living.
- Urban sprawl describes areas experiencing gentrification through increasing population density, proximity to urban centers, home values, and the cost of living. A high rank indicates a population more vulnerable to gentrification.

Mapping for gentrification indices shows that the Town of Barnstable has medium to high levels of housing disruption. For both retiree migration and urban sprawl, the levels are medium to low pressure.

Environmental justice analyses must also address impacts on Native American tribes. Federal agencies should evaluate "interrelated cultural, social, occupational, historical, or economic factors that may amplify the natural and physical environmental effects of the proposed agency action," and “recognize that the impacts within… Indian tribes may be different from impacts on the general population due to a community’s distinct cultural practices” (CEQ 1997). Factors that could lead to a finding of significance to environmental justice populations include loss of significant cultural or historical resources and the impact’s relation to other cumulatively significant impacts (USEPA 2016).

The geographic analysis area for environmental justice includes the Chappaquiddick Island TCP, which includes the western portion of Martha’s Vineyard. In addition, the Nantucket Sound TCP and Vineyard Sound and Moshup’s Bridge TCP include coastal areas of Martha’s Vineyard and Nantucket, as well as areas of open water. BOEM has invited the following federally recognized tribes with ancestral associations to lands within the geographic analysis area to participate in government-to-government consultation and the NHPA Section 106 consultation process: the Delaware Tribe of Indians, the Mashantucket (Western) Pequot Tribal Nation, the Mashpee Wampanoag Tribe of Massachusetts, the Mohegan Tribe of Connecticut, the Delaware Nation, the Narragansett Indian Tribe, the Shinnecock Indian Nations, and the Wampanoag Tribe of Gay Head (Aquinnah). Section 3.10, Cultural Resources; and Appendix J, Finding of Adverse Effect for the New England Wind Project Construction and Operations Plan, and the Cumulative Historic Properties Visual Effects Assessment (BOEM 2022f) describe the proposed Project’s impacts on tribal resources.

3.12.2 Environmental Consequences

Definitions of potential impact levels for environmental justice are provided in Table 3.12-2.

Table 3.12-2: Impact Level Definitions for Environmental Justice

Impact Level	Impact Type	Definition
Negligible	Adverse	Adverse impacts on environmental justice populations would be small and unmeasurable.
	Beneficial	Beneficial impacts on environmental justice populations would be small and unmeasurable.
Minor	Adverse	Adverse impacts on environmental justice populations would be small and measurable but would not disrupt the normal or routine functions of the affected population.
	Beneficial	Environmental justice populations would experience a small and measurable improvement in human health, employment, facilities or community services, or other economic or quality-of-life improvement.
Moderate	Adverse	Environmental justice populations would have to adjust somewhat to account for disruptions due to notable and measurable adverse impacts.
	Beneficial	Environmental justice populations would experience a notable and measurable improvement in human health, employment, facilities or community services, or other economic or quality-of-life improvement.
Major	Adverse	Environmental justice populations would have to adjust to significant disruptions due to notable and measurable adverse impacts. The affected population may experience measurable long-term impacts.
	Beneficial	Environmental justice populations would experience a substantial long-term improvement in human health, employment, facilities or community services, or other economic or quality-of-life improvement.

3.12.2.1 Impacts of Alternative A – No Action Alternative on Environmental Justice

When analyzing the impacts of Alternative A on environmental justice, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the existing conditions for environmental justice (Table G.1-9 in Appendix G, Impact-Producing Factor Tables and Assessment of Resources with Minor [or Lower] Impacts). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for environmental justice described in Section 3.12.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on environmental justice include regional demographic and economic trends. While the proposed Project would not be built under Alternative A, ongoing activities, future non-offshore wind activities, and future offshore wind activities would continue to sustain and support growth of the geographic analysis area’s diverse economy, based on anticipated population growth and ongoing development of businesses and industry. Environmental impacts of these economic activities would continue to affect environmental justice communities. Tourism, recreation, and ocean economy activities, which employ individuals who meet environmental justice criteria, would continue to be important to the economies of the coastal areas, especially Barnstable, Nantucket, Washington, and Dukes counties. Marine industries such as commercial fishing and shipping would continue to be active and important components of the regional economy. Counties in the geographic analysis area would continue to seek to diversify their economies, protect environmental resources, and maintain or increase their year-round population, thus affecting existing environmental justice communities and populations.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on environmental justice include continued operation of the Block Island Wind Farm and ongoing construction of Vineyard Wind 1 in OCS-A 0501 and the South Fork Wind Project in OCS-A 0517. Ongoing operation of the Block Island Wind Farm and ongoing construction of Vineyard Wind 1 and

South Fork Wind Project, along with planned offshore wind activities, would affect environmental justice through the primary IPFs described below.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than Alternative B). In addition to the regional economic impact of a growing offshore wind industry, future offshore wind development would affect environmental justice through the following IPFs.

Air emissions: Increased port activity would generate short-term, variable increases in air emissions. As stated in Section G.2.1, Air Quality, the largest emissions for regulated air pollutants would occur during construction from diesel construction equipment, vessels, and commercial vehicles. Emissions at offshore locations would have regional impacts, with no disproportionate impacts on environmental justice communities.

Environmental justice communities near ports could experience disproportionate air quality impacts depending on the ports that are used, ambient air quality, and the increase in emissions at any given port. As described in Appendix E, up to six other offshore wind projects could be under construction simultaneously in 2025, and all projects in the RI/MA Lease Areas would be constructed between 2022 and 2030. The ports designated for use during construction of these other projects have not been identified but may include some of the ports identified for potential use during proposed Project construction. As described in Section 3.12.1, many of these ports are near environmental justice communities.

During construction, Alternative A emissions of criteria pollutants for criteria pollutants nitrogen dioxide (NO_2), carbon monoxide (CO), particulate matter smaller than 10 microns (PM_{10}), particulate matter smaller than 2.5 microns ($PM_{2.5}$) sulfur dioxide (SO_2), and volatile organic compounds would equal 42,821 tons over the total life of the projects (Section G.2.1). Construction emissions of nitrogen oxide (NO_x) and CO are primarily due to diesel construction equipment, vessels, and commercial vehicles. CO_2 makes up the largest percentage of construction-stage emissions at 2.23 million tons over the life of the proposed Project. The geographic analysis area for air quality (Figure G.2.1-1) is larger than the geographic analysis area for environmental justice. Thus, a large portion of the emissions would be generated along the vessel transit routes and in the OECC and SWDA rather than at ports near environmental justice communities. Emissions would vary spatially and temporally during construction stages 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 Alternative A affecting any neighborhood have not been quantified; however, it is assumed that emissions from Alternative A at ports would comprise a small proportion of total emissions from those facilities and a small proportion of the total emissions affecting nearby environmental justice communities, regardless of source. The air emissions impacts of Alternative A would be greater if multiple offshore wind projects simultaneously use the same port for construction staging and could be less intense in any single environmental justice community if construction activity is distributed among several ports.

Future offshore wind projects within the air quality geographic analysis area would overlap during operations, but operations would contribute fewer criteria pollutant emissions compared to construction and decommissioning and would come largely from commercial vessel traffic and emergency diesel generators. The largest emissions would be NO_x (3,340 tons per year) and CO (780 tons per year). The other criteria pollutants would each account for approximately 50 to 100 tons per year of operations emissions (Section G.2.1). Operations air emissions would overall be short term, intermittent, widely dispersed, and generally contribute to minimal and localized air quality impacts. The ports used for operations at future offshore wind projects have not been identified but may include some of the ports used for construction.

The power generation capacity of offshore wind could potentially lead to lower regional air emissions by displacing fossil fuel plants for power generation, resulting in potential reduction in regional GHG emissions (Section G.2.1). Nationwide, exposure to fine particulate matter from fossil fuel electricity generation in the United States varies by income and race, with average exposures highest for Black individuals, followed by non-Hispanic White individuals. Exposures for other groups (i.e., Asian, Native American, and Hispanic) were somewhat lower. Exposures were higher for lower income populations than for higher income populations, but disparities were larger by race than by income (Thind et al. 2019). Although not specific to power generation, average population-weighted $PM_{2.5}$ and NO_2 concentrations in Massachusetts were highest for urban non-Hispanic Black populations and urban Hispanic populations, respectively (Rosofsky et al. 2017).

Exposure to air pollution is linked to health impacts, including respiratory illness, increased health care costs, and mortality. A 2016 study for the Mid-Atlantic region found that offshore wind could produce measurable benefits measured in health costs and reduction in loss of life due to displacement of fossil fuel power generation (Buonocore et al. 2016). Environmental justice populations in Massachusetts have disproportionately high exposure to air pollutants, likely leading to disproportionately high adverse health consequences. Accordingly, offshore wind generation analyzed under Alternative A would have potential benefits for environmental justice populations through reduction or avoidance of air emissions and associated reduction or avoidance of adverse health impacts. Operation of other offshore wind projects in the RI/MA Lease Areas would displace or avoid emissions from fossil fuel power generation and could potentially avoid \$4.64 to \$10.32 billion in annual health costs and 463 to 971 annual deaths (Section G.2.1).

Cable emplacement and maintenance: Cable emplacement for offshore wind projects in the RI/MA Lease Areas (other than the proposed Project) would affect approximately 21,975 acres of seafloor (Appendix E), all of which would be in open waters outside of the counties included in the geographic analysis area for environmental justice. Assuming future projects use offshore and onshore installation procedures similar to those described for the proposed Project (COP Volume I, Sections 3.3.1 and 4.3.1; Epsilon 2022a), cable emplacement could displace other marine activities for a period of 1 day to several months within offshore cable installation areas. Cable installation and maintenance would have localized, temporary, short-term impacts on the revenue and operating costs of commercial and for-hire fishing businesses (Section 3.9, Commercial Fisheries and For-Hire Recreational Fishing). Commercial fishing operations may temporarily be less productive during cable installation or repair, resulting in reduced income and also leading to short-term reductions in business volumes for seafood processing and wholesaling businesses that depend on the commercial fishing industry. Although commercial and for-hire fishing businesses could temporarily adjust their operating locations to avoid revenue loss, 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 affect 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 and localized impacts on low-income residents and tribal members who rely on subsistence fishing as a food source, as well as tribal members for whom fishing and clamming is also a cultural practice.

Cable emplacement could damage submerged ancient landforms that may have cultural significance to Native American tribes as part of ancient and ongoing tribal practices and as portions of a landscape occupied by their ancestors (Section 3.11). Disturbance and destruction of even a portion of an identified submerged landform could degrade or even eliminate the value of these resources as potential repositories of archaeological knowledge and cultural significance to tribes. If these landforms are disturbed during offshore cable emplacement, the impact on the cultural resource would be permanent, resulting in a disproportionately large and adverse impact on the affected Native American tribes.

Maintenance activities for other offshore wind projects could potentially overlap temporally and spatially with Phase 1 cable maintenance activities, but such overlaps would be rare.

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 and variable impacts on environmental justice communities could result from land disturbance, depending on the particular location of onshore construction for each offshore wind project.

Lighting: The view of nighttime aviation warning lighting required for offshore wind structures could have impacts on economic activity in locations where lighting is visible, by affecting the decisions of tourists or visitors in selecting coastal locations to visit. Service industries that support tourism are a source of employment and income for low-income workers. Impacts on tourism are anticipated to be localized, not industry-wide (Section 3.15, Recreation and Tourism), and would, thus, have little impact on environmental justice populations. Lighting on WTGs could also affect cultural and historic resources, including views of night sky and the ocean that are important to Native American tribes. Section 3.10 evaluates visual resources impacts on historic and cultural resources.

As additional offshore wind projects become operational, the nighttime lighting would be visible from a greater number of coastal locations. The aviation hazard lighting from approximately 903 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. Aviation hazard lighting is evaluated as part of the discussion of visual impacts on recreation and tourism in Section 3.11. The impacts on recreation- and tourism-related economic activity, if any, would be long term and continuous and could, in turn, have impacts on environmental justice populations, specifically low-income employees of tourism-related businesses. The visual impact of nighttime lighting would contribute to the disproportionately adverse visual impact on cultural resources important to Native American tribes, described under the presence of structures IPF. BOEM assumes that ongoing and planned offshore wind projects would also include ADLS, which would substantially reduce the amount of time aviation hazard lighting is used (Section 3.16, Scenic and Visual Resources).

Noise: 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 impacts on commercial and for-hire fishing and marine sightseeing businesses. The severity of impacts would depend on the proximity and temporal overlap of offshore wind survey and construction activities, as well as 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 affect subsistence fishing by low-income residents and tribal members. In addition, noise would 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 and short-term impacts during maintenance. Noise impacts during surveying and construction would be more widespread when multiple offshore wind projects are under construction at the same time. The impacts of offshore noise on marine businesses and subsistence fishing would have short-term and localized impacts on low-income workers in marine-dependent businesses, as well as residents or tribal members who practice subsistence fishing and clamming, resulting in impacts on environmental justice populations. It is anticipated that most offshore construction activities would take place in the summer due to more favorable weather conditions. Thus, commercial/for-hire fisheries and marine sightseeing businesses most active in the summer would likely be impacted more than those active during 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 on the location of onshore construction in relation to businesses or environmental justice communities. Impacts on environmental justice communities would be short term and intermittent and would be similar to impacts from common onshore utility construction activity in the geographic analysis area not associated with offshore wind projects.

Noise generated by offshore wind construction activity at ports would potentially impact environmental justice communities near the ports described in Section 3.12.1. 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 where intervening buildings, roads, or topography lessen the intensity of noise in nearby residential neighborhoods or if ports implement noise reduction mitigations for motorized vehicles and equipment.

Port utilization: Impacts on environmental justice communities near ports in the geographic analysis area (Section 3.12.1) would result from increased air emissions and noise generated by port utilization or expansion. Aside from these impacts, actual use and expansion of ports resulting from offshore wind would have beneficial impacts on employment at ports. Improvements and expansions to support offshore wind development are underway or completed at several ports in the geographic analysis area (Section 3.11). Port utilization for offshore wind would have short-term beneficial impacts for environmental justice populations during construction and decommissioning, resulting from employment opportunities, 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: The WTGs, ESPs, and hard protection for cables associated with other offshore wind projects would affect employment and economic activity generated by marine-based businesses (Sections 3.9 and 3.11). Commercial fishing businesses would need to adjust routes and fishing grounds to avoid offshore work areas during construction and WTGs and ESPs during operations. Concrete cable protection and scour protection could result in gear loss and would make some fishing techniques unavailable in locations where cable protection 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 occur within wind development areas (whereas other fisheries 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, potentially 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 short term and increase in magnitude when multiple offshore construction areas exist at the same time. As many as six offshore wind projects (excluding the proposed Project) could be under construction simultaneously in the waters offshore from the geographic analysis area in 2025. 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 as any temporary marine safety zones needed for construction are no longer needed.

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

Views of offshore WTGs could affect 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. Portions of all 903 WTGs associated with Alternative A could potentially be visible from south-facing shorelines and elevated areas, including lands and resources of significance to Native American tribes, as well as other areas that meet environmental justice criteria (Figures 3.12-3 through 3.12-5), depending on vegetation, topography, weather, and atmospheric conditions. Due to the significance of the resources to Native American tribes, views of WTGs from Alternative A would have a disproportionate and adverse impact. These WTGs would not dominate offshore views, even when weather and atmospheric conditions allow clear views (Section 3.16). 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 3.11). Therefore, views of offshore WTGs are not anticipated to disproportionately impact other environmental justice populations, specifically low-income employees of tourism-related businesses.

Views of WTGs would affect cultural resources, including the Gay Head Lighthouse, as well as the Chappaquiddick Island, Vineyard Sound and Moshup's Bridge, and Nantucket Sound TCPs that are important to Native American tribes. BOEM has consulted with Native American tribes for whom views within TCPs are culturally important, as part of the review under the NHPA Section 106 (Section 3.10).

Traffic: Offshore wind construction, decommissioning, and, to a lesser extent, operations would generate increased vessel traffic. The volume of vessel traffic during construction would complicate marine navigation in the offshore construction areas and create the potential for vessel congestion, reduced capacity, and competition for docks and berths within and near the ports that support offshore wind construction. 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 as part of tribal practices) 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 projects could increase port-related vessel congestion, although impacts could be reduced by appropriate port planning and preparation. Accordingly, vessel traffic generated by offshore wind project construction would have short-term and 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 on the navigation patterns and the extent of facility preparation and planning at each 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.

Conclusions

Impacts of Alternative A. Under Alternative A, environmental justice communities would continue to be affected by existing regional trends and respond to current and future environmental and societal activities. Notable ongoing trends include continued coastal development and gentrification of coastal communities; the continued importance of commercial shipping, commercial and recreational fishing, seafood processing, and tourism industries as employment sources for low-income residents; air emissions, noise, lighting, and traffic associated with onshore construction and land uses; periodic port and coastal infrastructure maintenance and upgrades; periodic channel dredging; and the use of small-scale onshore renewable energy. While the proposed Project would not be built under Alternative A, ongoing activities related to the IPFs, such as those listed above, would have **minor** adverse impacts and **minor** beneficial impacts on environmental justice communities.

Cumulative Impacts of Alternative A. Planned activities for coastal and marine activity other than offshore wind include development of diversified, small-scale, onshore renewable energy sources and peaker plants; ongoing onshore development at or near current rates; continued increases in the size of commercial vessels; potential port expansion and channel deepening activities; and efforts to protect against potential increased storm damage and sea level rise. The cumulative impacts on environmental justice communities would be **minor**, both adverse and beneficial, driven primarily by the continued operation of existing marine industries, especially commercial fishing, recreation/tourism, and shipping; increased pressure for environmental protection of coastal resources; the need for port maintenance and upgrades; and the risks of storm damage and sea level rise.

3.12.2.2 Relevant Design Parameters and Potential Variances in Impacts

Impacts on environmental justice communities would occur when the proposed Project's impacts on other resources, such as air quality, water quality, employment and economics, cultural resources, recreation and tourism, commercial fishing, or navigation, are felt disproportionately within environmental justice communities, due either to the location of these communities in relation to the proposed Project or to their higher vulnerability to impacts. The following proposed Project design parameters (Appendix C, Project Design Envelope and Maximum-Case Scenario) would influence the magnitude of impacts on environmental justice:

- Two different maximum-case scenarios for environmental justice:
  - The maximum-case scenario for income and employment would be 130 WTGs (the maximum number of WTGs 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; and
  - The maximum-case scenario for visual impacts, including visual impacts that affect businesses that employ workers from environmental justice communities, as well as visual impacts on cultural resources of significance to Native American tribes, would be 130 of the largest (and tallest) WTGs, each with maximum vertical blade tip height of 1,171 feet MLLW and maximum nacelle-top height of 725 feet MLLW. Use of the tallest WTGs would increase the number and portion of WTGs visible from cultural resources.
- The time of year construction occurs. The applicant would likely schedule onshore construction to take place after Labor Day and before Memorial Day, outside of the busiest tourist season on Cape Cod, Martha's Vineyard, and Nantucket (COP Volume I, Section 3.3.1; Epsilon 2022a). If the schedule were to shift such that construction of the cable landfalls and OECRs occurred during the tourist season, the proposed Project would have substantially larger impacts on land use, employment and economics, and recreation and tourism, which could disproportionately affect environmental justice communities; and

- The ports chosen for construction support and the improvements needed at those ports to support offshore wind activity, including the proposed Project.

3.12.2.3 Impacts of Alternative B – Proposed Action on Environmental Justice

This section identifies the potential impacts of Alternative B on environmental justice.

Impacts of Phase 1

Phase 1 would affect environmental justice through the following primary IPFs during construction, operations, and decommissioning.

Air emissions: Emissions at offshore construction locations would have regional impacts, with no disproportionate impacts on environmental justice communities. However, environmental justice communities near ports, the OECRs, and onshore substation site could experience disproportionate air quality impacts, depending on the ports that are used, ambient air quality, and the increase in emissions at any given port.

As discussed in Section 3.12.1 and shown on Figures 3.12-2 through 3.12-15, all of the Phase 1 construction ports except the Shoreham site and Port of Coeymans are near or within environmental justice communities. Phase 1's contributions to increased air emissions at ports identified for potential use for construction activities near environmental justice communities (i.e., county-level emissions) are not available. As discussed in detail in Section G.2.1, communities near Vineyard Haven Harbor, the Port of Bridgeport, the New London State Pier, the Paulsboro Marine Termina, and the ports in Kings, Richmond, and Suffolk counties, New York (Table 3.12-1) are in designated nonattainment and/or maintenance areas for one or more criteria pollutants. Also, as discussed in Section G.2.1, overall air emissions impacts would be minor during Phase 1 construction, with the greatest quantity of emissions produced within the SWDA and by vessels transiting from ports to the SWDA. As a result, air emissions from Phase 1 would have **negligible** impacts on environmental justice communities near the ports and onshore proposed Project facilities.

Other offshore wind projects using ports within the geographic analysis area for environmental justice populations would overlap with Phase 1 construction and generate short-term air quality impacts at ports, in transit between ports and offshore construction areas, and within the offshore construction areas for each other offshore wind project. As shown in Figures 3.12-2 through 3.12-15, most of the 19 ports listed in Table 3.12-1 are adjacent to or near communities that meet state or federal environmental justice criteria. As discussed in Section 3.13, Navigation and Vessel Traffic, and Section G.2.7, Land Use and Coastal Infrastructure, some ports in the region are being expanded, and other new ports have been proposed to serve the offshore wind industry as a whole. The applicant has not stated which ports would be used for Phase 1 (or Phase 2) construction, or the level of activity at any single port. No port expansions would occur as a direct result of Phase 1 (COP Volume I, Section 3.2.2.5; Epsilon 2022a). Most air emissions would occur at offshore locations rather than at the ports. As a result, the air quality impacts of Phase 1 construction would be **negligible** for any single community and **negligible** to **minor** overall.

Net reductions in criteria air pollutant emissions due to Phase 1 operations would result in long-term benefits to communities (regardless of environmental justice status) by displacing or avoiding emissions from fossil fuel-generated power plants. Based on the overall health benefits of Alternative A, as discussed in Section G.2.1, displacing 804 MW of fossil fuel power generation with an equivalent amount of offshore wind power generation from Phase 1 could potentially avoid $169 to $377 million in annual health costs and 17 to 35 annual deaths that would otherwise have resulted from air emissions. As noted under Alternative A, minority and low-income populations are disproportionately impacted by emissions from fossil fuel power plants nationwide and by higher levels of air pollutants. Therefore, Phase 1 could benefit environmental justice communities by displacing fossil fuel power-generating capacity within or near the geographic analysis area. As a result, operations of Phase 1 would have **negligible** to **minor** beneficial impacts on environmental justice communities throughout the geographic analysis area.

Cable emplacement and maintenance: Cable emplacement for Phase 1 would temporarily impact commercial/for-hire fishing businesses, marine recreation, and subsistence fishing during cable installation. Phase 1 cable emplacement would have short-term, localized, and **minor** impacts on marine businesses (commercial fishing or recreation businesses) and subsistence fishing (Section 3.11). Construction of offshore components for Phase 1 would, therefore, have a short-term and **minor** impact on low-income workers in marine businesses. BOEM is evaluating the following mitigation and monitoring measure to address impacts on environmental justice, as described in detail in Table H-2 of Appendix H, Mitigation and Monitoring. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

- Continue to engage with environmental justice communities (including, but not limited to, federally recognized Native American tribes) within the geographic analysis area to increase awareness of, and potential participation in, proposed fishing compensation, trust, and innovation funds.

This mitigation and monitoring measure could marginally reduce impacts on tribe members in the commercial or recreational fishing industries; however, the magnitude of these impacts would remain **minor**.

Cable emplacement would disrupt submerged ancient landforms that hold cultural significance for Native American tribes. Marine geophysical remote sensing studies performed for Phase 1 identified 26 submerged landform features (stream channel, lake, and estuarine landscape features) within the SWDA and OECC (Section 3.10). While HRG and geotechnical studies for the proposed Project did not find any direct evidence of pre-contact period Native American cultural materials, the submerged landforms are considered culturally significant by regional Native American tribes as portions of a landscape occupied by their ancestors. Disturbance and destruction of even a portion of an identified submerged landform could threaten the value of these resources as potential repositories of archaeological knowledge and cultural significance to tribes. Construction of Phase 1 would result in large-scale, permanent impacts on 25 submerged landforms. With implementation of a treatment plan agreed to by all parties, Section 3.10 concludes that impacts on submerged landforms would be **major**, due to reduced value and integrity of the submerged landscapes. As a result, cable emplacement would also result in **major** environmental justice impacts on the Native American tribes that consider the submerged landscapes to be part of their ancient and ongoing tribal practices and as portions of a landscape occupied by their ancestors.

During NHPA Section 106 consultation for Vineyard Wind 1 (BOEM 2021b), the state-recognized Chappaquiddick Wampanoag Tribe raised concerns regarding sediment plumes, coastal erosion, and cable installation from Vineyard Wind 1 on natural and cultural resources on Chappaquiddick Island. In particular, concerns were raised about potential increase in shoreline erosion along Chappaquiddick Island at the eastern end of Martha’s Vineyard, which could impact traditional hunting, fishing, and shellfishing. The Phase 1 OECC would be at approximately 3,900 feet offshore from the Chappaquiddick Island shoreline at its closest point. Section 3.4, Benthic Resources, concludes that the impacts of cable emplacement on sediment deposition and burial would be minor, based on the applicant’s modeling of the potential distribution of suspended sediment during dredging and cable installation (COP Appendix III-A; Epsilon 2022a). The sediment model indicated that sediment deposition greater than 0.04 inch would be mostly limited to within approximately 492 feet of the cable centerline (COP Appendix III-A; Epsilon 2022a). Accordingly, cable emplacement from Phase 1 would have a **negligible** impact on fishing and shellfishing practices of the state-recognized Chappaquiddick Wampanoag Tribe due to coastal erosion and sediment deposition on Chappaquiddick Island.

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 Phase 1 would be temporary and variable, with **negligible** impacts on environmental justice communities.

Cable emplacement and maintenance during Phase 1 operations would temporarily affect commercial/for-hire fishing businesses, marine recreation, and subsistence fishing during infrequent cable maintenance activities. These maintenance activities would have short-term, localized, and **minor** impacts on marine businesses (commercial fishing or recreation businesses) and subsistence fishing (Section 3.11) and would, therefore, have a short-term and **negligible** impact on low-income workers in marine businesses.

Cables emplaced during construction would continue to affect cultural resources, especially submerged landform features. Additional ground-disturbing activities associated with maintenance could result in additional disturbance and destruction of potential shipwrecks or identified submerged landform features, resulting in potentially **major** impacts on Native American tribes that consider the submerged landscapes part of their ancient and ongoing tribal practices and as portions of a landscape occupied by their ancestors.

Land disturbance: One route option for the Phase 1 OECR would pass through a census block group in Centerville (about 1.5 miles north of the Phase 1 cable landing sites) that meets environmental justice criteria for minority population status (Figure 3.12-3), and the majority of the Phase 1 OECR would be within 1 mile of block groups that meet low-income and/or minority environmental justice criteria (Figure 3.12-5). Construction of the OECR would temporarily disturb neighboring land uses through construction noise, vibration, and dust, as well as delays in travel along the impacted roads. All block groups (and the communities they contain) would equally experience these impacts, regardless of environmental justice status, and access to neighborhoods would be maintained. Construction of landfall sites would occur outside of peak summer tourist season (i.e., Memorial Day to Labor Day) and only affect a portion of the parking lots at Craigville Beach or Covell’s Beach. Accordingly, land disturbance from the onshore construction of Phase 1, including the OECR and landfall sites, would have temporary and **negligible** impacts on environmental justice communities. Phase 1’s onshore land disturbance activities are not anticipated to overlap in location with other offshore wind projects.

During operations, the onshore transmission cable infrastructure, including cable landfall sites and onshore cables, would be underground and primarily within roads and utility ROWs, while the substation would operate within an industrial area. As a result, operations and occasional maintenance or repair operations from Phase 1 would have **negligible** impacts and would not result in disproportionate impacts on environmental justice communities.

Lighting: Phase 1 would not include nighttime onshore construction, except as specifically permitted or requested by local permitting authorities (COP Volume I, Section 3.3.1.1.1; Epsilon 2022a). Nighttime construction of Phase 1 would require lighting for vessels in transit and at offshore construction work areas. Phase 1 vessel lighting would not have measurable impacts; therefore, lighting from Phase 1 would have short-term and **negligible** impacts. Vessel lighting from other offshore wind projects would have similar impacts as Phase 1 but at different locations and times. If lighting from vessels occurred simultaneously, the impacts on environmental justice communities from ongoing and planned activities, including Phase 1, would also be short term and **negligible**.

Aviation hazard lighting on WTGs could be visible from coastal locations on Martha’s Vineyard and Nantucket, depending on vegetation, topography, weather, and atmospheric conditions. Nighttime lighting would affect views of the horizon and the night sky from locations with historic and cultural importance to Native American tribes (Section 3.10). Because the proposed Project would use ADLS, aviation hazard lighting would be activated less than 0.1 percent of annual nighttime hours per year (Section 3.16). As a result, the lighting of offshore structures from Phase 1 would result in a long-term, intermittent, and **negligible** impact on environmental justice communities due to the negligible impact on views important to Native American tribes and the recreation/tourism economic sector that provides employment for low-income workers.

Noise: Noise from Phase 1 construction (primarily pile driving) during offshore wind development would have short-term impacts on fish (Section 3.6, Finfish, Invertebrates, and Essential Fish Habitat) and marine mammals (Section 3.7, Marine Mammals). These increased impacts would affect the fishing and sightseeing businesses that rely on these species, resulting in impacts on employment, income, and subsistence fishing (Section 3.11). Phase 1 site assessment G&G survey activities, operations and maintenance, pile driving, trenching, and vessels would have short-term, intermittent, and **negligible** impacts on visitors, workers, and residents. Therefore, Phase 1 construction noise would have short-term and **negligible** impacts on the members of environmental justice populations who rely on subsistence fishing or employment and income from marine businesses. Similarly, offshore construction noise would have **negligible** impacts on cultural practices of and values held by Native American tribes related to fish, shellfish, or marine mammal populations. Sharing environmental monitoring data and reports, particularly those related to marine mammals, with federally recognized Native American tribes could help to address the tribes’ concerns about impacts on fish, shellfish, and marine mammal populations by providing documentation and the results of efforts to avoid, minimize, and/or mitigate impacts on culturally significant species.

Although no port expansion is proposed in connection with the proposed Project, noise generated by Phase 1 activity at ports would potentially have disproportionately high impacts on environmental justice communities near ports (Section 3.12.1), especially if no sound buffering exists between the port and those communities. As a result, noise from Phase 1 would have short-term, variable, and **negligible** to **minor** impacts on environmental justice communities near the ports. Noise from onshore construction of Phase 1 (for the substation and onshore cable route) would be temporary and variable, with **negligible** impacts on environmental justice communities.

Noise from Phase 1 operations would be similar to construction except for the absence of pile driving, which would occur infrequently during planned or unplanned maintenance activities. Noise from Phase 1 operations would, therefore, have **negligible** impacts on environmental justice communities. Noise from Phase 1 decommissioning is expected to have similar types of noise impacts, except for the absence of pile driving. Noise from Phase 1 decommissioning would, therefore, have **negligible** impacts on environmental justice communities.

Port utilization: As stated above, Phase 1 construction would use as many as 19 ports in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey (Section 3.12.1). Several of these ports are within, surrounded by, or near (i.e., within 1 mile of) populations that meet environmental justice criteria based on race/ethnicity, income, and/or linguistic isolation (COP Volume III, Section 7.2; Epsilon 2022a). Use and (in some cases) expansion of these ports for offshore wind activity is generally consistent with existing and designated future land use and other plans for these sites (Section G.2.7) and generally would not displace or adversely affect residents or existing businesses.

Phase 1 does not include expansion of any specific port but would use ports that have expanded or would expand to support the offshore wind energy industry. Contributions of Phase 1 to increased utilization of ports may have beneficial impacts on environmental justice communities due to increased employment opportunities and business activity. BOEM could require the applicant, as a condition of COP approval, to prepare a local hiring plan similar to the plan developed for Vineyard Wind 1 (BOEM 2021b). Such a plan could enhance local hiring, possibly including hiring of low-income or minority residents of the geographic analysis area. The additional requirement described in Appendix A, Required Environmental Permits and Consultations, to coordinate with the federally recognized Mashpee Wampanoag Tribe of Massachusetts and Wampanoag Tribe of Gay Head (Aquinnah) during implementation of the local hiring plan, when possible and appropriate, could result in increased employment opportunities for members of these tribes. The impacts of Phase 1 on environmental justice communities from increased port utilization could result from temporary air emissions and noise during construction and would be **negligible**, in addition to the potential **minor** beneficial impacts of new hiring and economic activity for local businesses.

Phase 1 operations would include operations facilities and activities at Bridgeport, Vineyard Haven, and potentially Greenport Harbor, all of which are within or near potential environmental justice communities. Impacts associated with port utilization during Phase 1 operations would be similar to the construction impacts but would only occur in the operations ports. Operations activities in these ports would contribute positively to employment opportunities and economic activity within or near environmental justice communities and would have no disproportionate or adverse impacts on low-income or minority populations. As a result, Phase 1 operations would have localized, long-term, and **negligible** impacts on environmental justice populations near operations ports due to air and noise emissions, as well as **minor** beneficial impacts on environmental justice populations due to hiring and economic activity.

Presence of structures: Construction of WTGs, ESPs, and hard cover for cables would result in both adverse and beneficial impacts on marine businesses and subsistence fishing. Beneficial impacts would be generated by the reef effect of offshore structures, which could provide additional opportunity for subsistence fishing, tour boats, and for-hire recreational fishing businesses. Adverse impacts would result from navigational complexity within the SWDA, disturbance of customary routes and fishing locations, and the presence of scour protection and cable hard cover, leading to possible equipment loss and limited commercial fishing methods. Overall, the offshore structures for Phase 1 would have minor to moderate impacts on marine businesses (Sections 3.15 and 3.16), resulting in long-term, continuous, and **minor** impacts on environmental justice populations due to the impact on low-income workers in marine industries and low-income residents and tribal members who rely on subsistence fishing.

Portions of all of Phase 1's WTGs could potentially be visible from coastal locations on Martha's Vineyard, Nantucket, and mainland Cape Cod, depending on vegetation, topography, and atmospheric conditions. 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 (Section 3.15). Views of WTGs associated with Phase 1 are, therefore, anticipated to have a **negligible** impact on environmental justice populations based on the minimal anticipated impact on low-income employees of the recreation and tourism economic sector.

The impacts of offshore wind activities on maritime views along the southern coasts of Martha's Vineyard, Nantucket, Cape Cod, and nearby islands would be experienced equally by all populations; however, the visible presence of offshore wind structures would have disproportionate impacts on certain Native American tribes, due to the cultural significance of some ocean views. Visual impacts on certain views with cultural significance to Native American tribes are addressed in detail through the NHPA Section 106 consultation and tribal consultation, as discussed in Section 3.10 and Appendix J. Phase 1 WTGs would adversely affect the Gay Head Lighthouse and the Chappaquiddick Island, Vineyard Sound and Moshup's Bridge, and Nantucket Sound TCPs (Section 3.10). Views from the Gay Head Cliffs and Aquinnah Cultural Center (near the Gay Head Lighthouse property) and portions of the Chappaquiddick Island TCP have historic and cultural significance for the federally recognized Wampanoag Tribe of Gay Head (Aquinnah) and the state-recognized Chappaquiddick Wampanoag Tribe, respectively. 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 (BOEM 2022f). In addition, Phase 1 would only affect southern views from these resources. To further minimize and mitigate Phase 1's impacts, Vineyard Wind has voluntarily committed to using ADLS and non-reflective pure white (RAL Number 9010) or light gray (RAL Number 7035) paint on offshore infrastructure to minimize daytime visual impacts.

The final minimization and mitigation of adverse impacts would be determined through completion of BOEM's NHPA Section 106 review process and included as conditions of COP approval, but Section 3.10 concludes that the visual impact on the historic resources would be negligible. Accordingly, Phase 1, with the mitigation listed above, would have a long-term, continuous, disproportionately adverse, and **moderate** impact on Native American tribes including the federally recognized Wampanoag Tribe of Gay Head (Aquinnah) and the state-recognized Chappaquiddick Wampanoag Tribe.

Traffic: Phase 1 construction would generate vessel traffic within and near the ports described in Section 3.12.1. Vessel traffic associated with Phase 1 construction would have a short-term and **minor** impact on commercial and for-hire recreational fishing (Section 3.11) due to increased vessel traffic near ports and at the SWDA. Based on the **minor** impacts on commercial and for-hire recreational fishing, construction of Phase 1 would have a short-term and **negligible** impact on low-income residents or tribal members involved in the commercial fishing industry or subsistence fishing.

Vessel traffic from Phase 1 and in combination with other offshore wind projects would also have **minor** beneficial impacts on environmental justice communities through increased employment and economic activity for marine transportation and supporting businesses.

Section 2.3 describes the non-routine activities associated with the Phase 1. Spills from maintenance or repair vessels or activities requiring repair of WTGs, equipment, or cables would generally require intense, temporary activity associated with oil spill response (COP Appendix I-F; Epsilon 2022a) or to address emergency conditions. The presence of unexpectedly frequent vessel activity in Bridgeport, Vineyard Haven Harbor, or Greenport Harbor, and in offshore locations over the OECC or near individual WTGs or ESPs, could temporarily prevent or deter subsistence or commercial fishing or for-hire recreational fishing, or tourist activities near the site of a given non-routine event. As a result, the impacts of non-routine activities resulting from Phase 1 on environmental justice populations would be **minor**. The impacts of unplanned vessel traffic from other offshore wind projects would be similar to those described for Phase 1, spread across the RI/MA Lease Areas and geographic analysis area for environmental justice.

Impacts of Phase 2

The environmental justice impacts of Phase 2 construction, operations, and decommissioning would be similar to, but marginally more extensive than, those described for Phase 1 for IPFs related to air emissions, lighting, cable emplacement and maintenance, port utilization, the presence of structures, land disturbance, and vessel traffic. The Phase 2 OECR would not cross any block groups that meet state or federal environmental justice criteria but would generally be in a similar location and have similar impacts on environmental justice communities as the Phase 1 OECR. While Phase 2 would involve more WTGs and ESPs, a greater length of inter-array cables, and a different OECR in Barnstable, the incremental differences in activity between Phase 2 and Phase 1, as well as the combined impact of Phase 1 and Phase 2 together, would not change any of the adverse or beneficial impact magnitudes described for Phase 1 construction.

If the applicant includes the SCV as part of the final proposed Project design, some or all of the impacts on environmental justice communities from Phase 2 in Barnstable County, Massachusetts, may not occur, while additional impacts could occur in Bristol County, Massachusetts. BOEM will provide a more detailed analysis of the impacts of the SCV and the Phase 2 OECC on environmental justice in a supplemental NEPA analysis.

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-9 in Appendix G would contribute to impacts on environmental justice through the primary IPFs of cable emplacement and maintenance and the presence of structures. These impacts would primarily occur through impacts on cultural practices and values of Native American tribes resulting from views of WTGs, as well as damage to submerged ancient landforms; impacts on shellfish and fish that are targeted by commercial, recreational, subsistence, and tribal fishing; and impacts on recreation and tourism activities.

The cumulative impacts on environmental justice would range from **negligible** to **major**, including some disproportionately adverse impacts on Native American tribes. Impacts on environmental justice communities near ports and onshore construction areas due to air emissions and noise would be **negligible** to **minor**.

Conclusions

Impacts of Alternative B. Alternative B would have **minor** impacts and **minor** beneficial impacts on environmental justice populations within the geographic analysis area based on all IPFs. This includes certain disproportionately adverse impacts on Native American tribes. During installation of the onshore cables and substation, the IPFs associated with Alternative B would result in **negligible** impacts on environmental justice communities due to air emissions and noise at ports and onshore construction sites. During both construction and operations, the impacts on low-income employees of marine industries and supporting businesses (commercial fishing, support industries, marine recreation, and tourism) from all IPFs would range from **negligible** to **minor.** The **minor** impacts would result from disruption of marine activities during offshore cable installation and the impacts on commercial and for-hire fishing resulting from the long-term presence of offshore structures. Damage to submerged landforms resulting from offshore construction would result in **major** disproportionate impacts on Native American tribes that trace their ancestry to these landforms. Coastal views of offshore structures would have impacts on cultural resources important to the federally recognized Wampanoag Tribe of Gay Head (Aquinnah) and the state-recognized Chappaquiddick Wampanoag Tribe, with **moderate** impacts on these tribes. Considering the combined impacts of all IPFs, Alternative B would have overall **minor** impacts on all environmental justice populations

Cumulative Impacts of Alternative B. The cumulative impacts on environmental justice in the geographic analysis area would be **minor** and **minor** beneficial**.** Impacts on low-income employees of marine industries and supporting businesses (commercial fishing, support industries, marine recreation and tourism) would be **minor**, based on the anticipated temporary disruption of marine activities due to offshore cable installation and construction noise and increased vessel traffic during construction, as well as long-term impacts on the marine-dependent businesses resulting from the long-term presence of offshore structures. Impacts on cultural resources significant to Native American tribes would include disproportionately adverse, and **moderate** impacts on culturally important ocean views and **major** impacts resulting from damage to submerged landforms during cable emplacement. Potentially beneficial impacts on environmental justice populations would result from port utilization and vessel traffic and the resulting employment and economic activity. Beneficial impacts could also result if wind energy displaces fossil fuel energy generation in locations that improve air quality and health outcomes for environmental justice populations. Impacts on environmental justice communities would occur when Alternative B’s adverse impacts on other resources, such as air quality, water quality, employment and economics, cultural resources, recreation and tourism, commercial fishing, or navigation, are felt disproportionately within environmental justice communities, due either to the location of these communities in relation to Alternative B or to their higher vulnerability to impacts.

3.12.2.4 Impacts of Alternative C – Habitat Impact Minimization Alternative on Environmental Justice

Alternatives C-1 and C-2 would not affect the number or placement of WTGs or ESPs for the proposed Project compared to Alternative B. While Alternatives C-1 and C-2 would alter the exact routes of inter-array, inter-link, and export cables installed for the proposed Project—and could, thus, affect the exact length of cable installed and area of ocean floor disturbed—these changes would not result in meaningfully different impacts on environmental justice compared to Alternative B. Therefore, the impacts of Alternatives C-1 and C-2 on environmental justice would be the same as those of Alternative B.

3.13 Navigation and Vessel Traffic

3.13.1 Description of the Affected Environment

3.13.1.1 Geographic Analysis Area

This section discusses existing navigation and vessel traffic in the geographic analysis area for navigation and vessel traffic, as described in Table D-1 in Appendix D, Geographical Analysis Areas, and shown on Figure 3.13-1. The geographic analysis area for navigation and vessel traffic extends within 12.4 miles of the RI/MA Lease Areas, the proposed Project OECC, and the area between the RI/MA Lease Areas and 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. These ports have been identified as suitable to support the offshore wind industry in Massachusetts and Rhode Island. Table G.1-10 in Appendix G, Impact-Producing Factor Tables and Assessment of Resources with Minor (or Lower) Impacts, describes existing conditions and potential impacts, based on the IPFs assessed of ongoing and future offshore activities other than offshore wind, which is discussed below.

3.13.1.2 Existing Navigation and Vessel Traffic

The coastal areas offshore Massachusetts, Rhode Island, and the rest of New England support a variety of vessel traffic, from cargo to tanker traffic, between major shipping and commercial ports from Boston to New York City. The area also supports commercial and private (recreational) fishing vessels, ferries, and other private recreational activities. Commercial and private vessel traffic make up the largest demographic for activities in the affected environment; however, other types of commercial traffic, including tanker, tug-and-barge and other commercial activities, are not common. The most substantial vessel traffic in and around the SWDA occurs in four primary geographic areas: Narragansett Bay, Buzzards Bay, Nantucket Sound, and the area between Woods Hole and Vineyard Haven. The most prevalent vessel route pattern through the SWDA and much of the geographic analysis area is a roughly southeast-to-northwest course (Figure 3.13-2) (COP Appendix III-I; Epsilon 2022a). Generally, BOEM does not anticipate any substantial changes to navigation and vessel traffic patterns in the geographic analysis area over the course of the next 30 years, except in response to offshore wind development, as discussed below.[24] Navigational safety considerations include factors such as crew alertness, vessel seaworthiness, sea conditions, and accessibility to search and rescue (SAR) assets. As discussed below, adding construction vessels and structures such as WTG 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.

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[24] A review of the 2016 through 2019 vessel traffic data shows that the prevalent vessel route pattern remains southeast to northwest, consistent with the Navigational Risk Assessment (COP Appendix III-I; Epsilon 2022a).

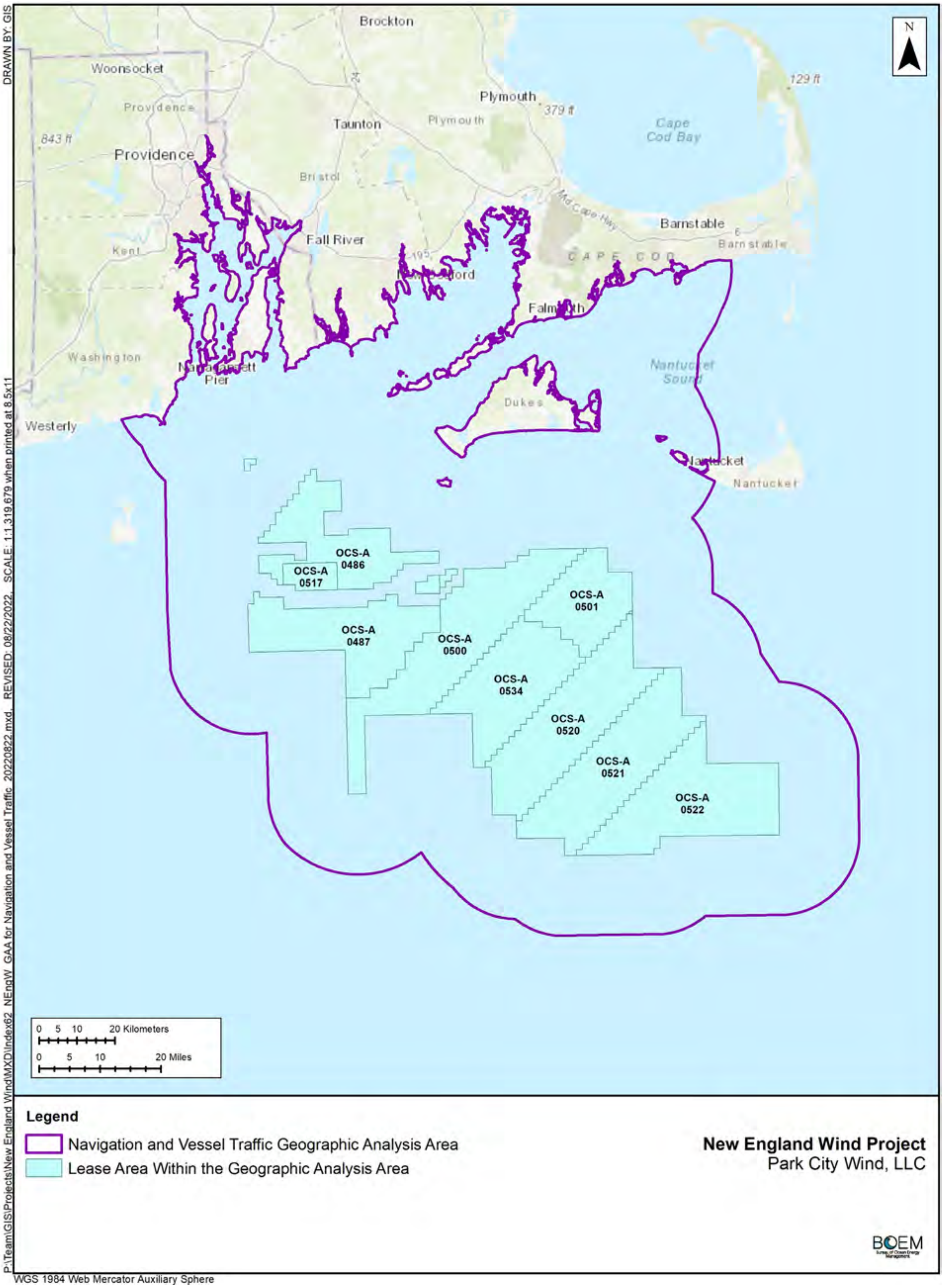

Figure 3.13-1: Geographic Analysis Area for Navigation and Vessel Traffic

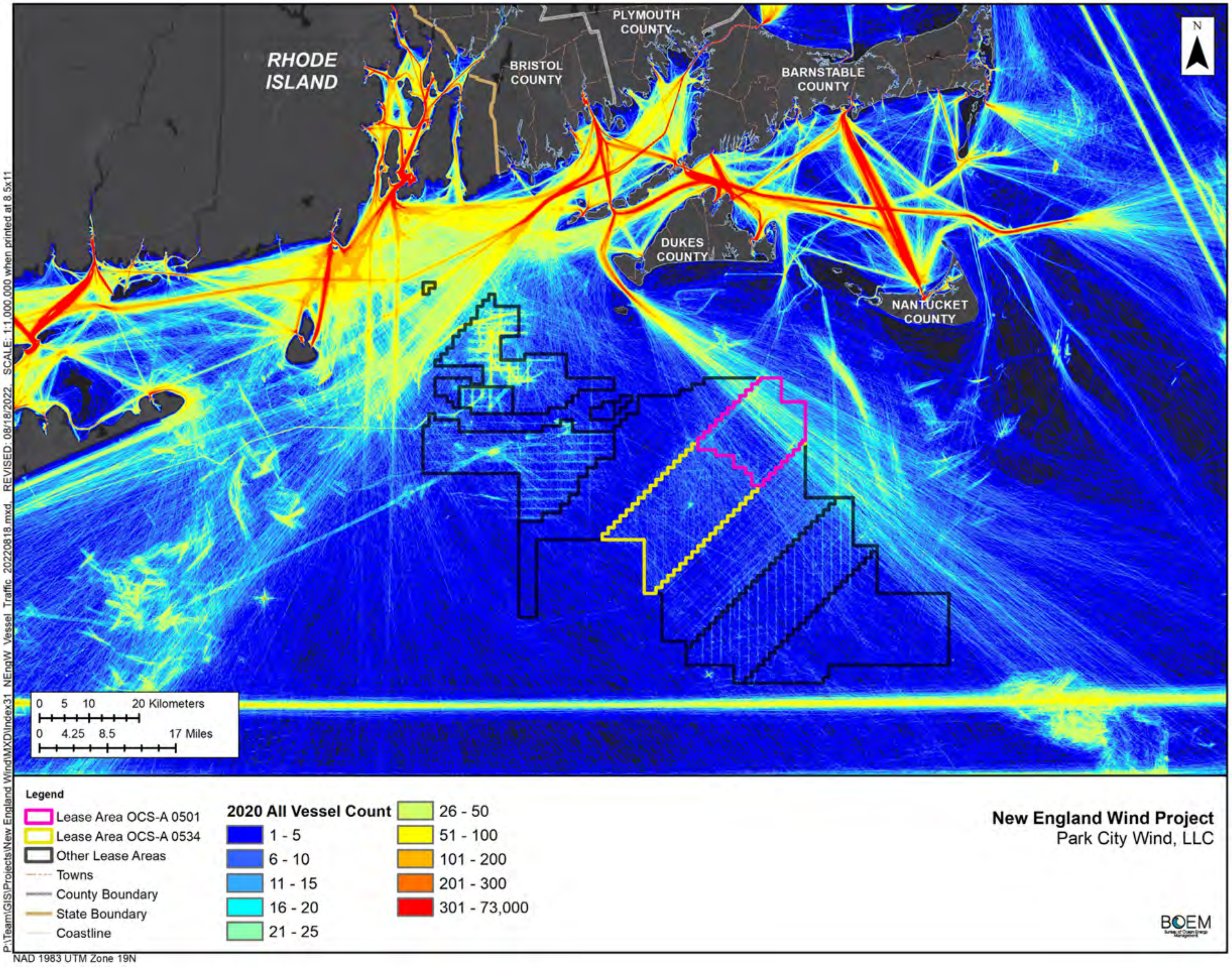

Figure 3.13-2: Vessel Traffic, 2020

This section discusses navigation and vessel traffic characteristics and potential impacts on the waterways and adjacent water approaches for the area specified within the SWDA, the MCT, and other port and operations facilities. Information presented in this section draws upon the NSRA for the proposed Project (COP Appendix III-I; Epsilon 2022a), which was prepared to comply with guidelines in the USCG's Navigation and Vessel Inspection Circular 02-07 (USCG 2007).

Proposed Project facilities would be located within and off the coast of Massachusetts, potentially supported by ports in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey.[25] Within the SWDA and the surrounding area, vessel traffic is primarily seasonal, with approximately 87 percent of all annual SWDA area traffic occurring between Memorial Day and Labor Day (COP Appendix III-I; Epsilon 2022a). This is primarily due to high seasonal activity by recreational vessels and commercial fishing vessels. Cargo vessel traffic is less seasonal. The coastal areas of these states support high volumes of vessel traffic. This includes cargo, tanker, and other heavy vessel traffic to and from major ports in Boston and New York City (NOAA 2022h), as well as commercial and recreational fishing, ferries, and other recreational vessel activity (Section G.2.6, Wetlands and Other Waters of the United States, and Section 3.14, Other Uses [National Security and Military Use, Aviation and Air Traffic, Offshore Cables and Pipelines, Radar Systems, Scientific Research and Survey, and Marine Minerals]). Figure 3.13-2 presents regional vessel traffic. General traffic patterns within the SWDA are relatively stable. Tankers, cargo, and passenger vessels generally follow steady southwest-to-northeast courses and transect the middle and southern sections of the SWDA, while towing/tug-barge vessels are distributed throughout the SWDA. However, AIS maps for 2020 show that a moderate volume of sailing, fishing, and other unspecified vessels traverse the geographic analysis area (Northeast Regional Ocean Council 2022). In relation to the location of typical transit routes south of the lease area and geographic analysis area, the commercial fishing industry has generally approached the issue of vessel transit in the southern New England lease areas holistically, rather than prioritizing one route over another. Essentially, vessel traffic in the lease area is widespread and generally without concentrated areas that would absolutely necessitate identification of formal routing measures.

Vessel Traffic

Table 3.13-1 summarizes the number and type of vessels recorded within 7.5 miles of the SWDA, the area studied in the applicant's NSRA(COP Appendix III-I; Epsilon 2022a). Commercial fishing vessels[26] and recreational vessels comprised more than 75 percent of the AIS tracks recorded in 2016 and 2019. The SWDA is frequented by commercial fishermen, however; data analysis show that the SWDA is primarily used by commercial fishermen engaged in activities such as transiting through the area, gillnetting, or trawling (COP Volume III, Section 4.1.7, Appendix III-I; Epsilon 2022a). Analysis on the relative duration of trawling within the confines of the SWDA revealed that for the trawl tracks that cross the SWDA, 23 percent of all time spent trawling is actually spent in the SWDA. (COP Appendix III-I; Epsilon 2022a). A summary of AIS fishing vessel traffic through the SWDA is presented in Table 3.13-2.

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[25] The applicant could also use ports in Canada; however, these areas are outside the scope of this analysis.

[26] There is some double counting of vessels between transiting and fishing. For the purposes of this analysis, it is assumed that fishing vessels with speeds less than 4 knots are trawling, while those with speeds greater than 4 knots are transiting the SWDA. Some fishing vessels have speeds both above and below 4 knots while in the SWDA and are counted as both in transit and trawling.

Table 3.13-1: Vessel Types Within the Southern Wind Development Area Based on 2016–2019 Automatic Identification System Data

Vessel Type	Number of Unique Vessels	Percentage of Unique Vessels (%)
Cargo vessels	112	13
Tankers	85	10
Passenger vessels	17	2
Tug-barge vessels	12	1
Military vessels	7	1
Naval sail training vessels	2	0
Recreational vessels	325	39
Fishing vessels, in transit	228	27
Fishing vessels, fishing	92	11
Other vessels	42	5
Total (2016-2019)[a]	**842**	**100**

Source: COP Appendix III-I; Epsilon 2022a

[a] The number of unique vessels sums to more than the total shown, due to double counting transiting and fishing vessels.

Table 3.13-2: Summary of Automatic Identification System Fishing Vessel Traffic through the Southern Wind Development Area (2016–2019)

Vessel Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Number of Tracks													
Fishing	1	0	2	6	17	15	38	234	345	32	2	4	695
Transiting	38	33	41	78	193	280	353	454	313	93	40	21	1,938
All vessels	38	33	41	79	195	286	363	605	539	105	40	24	2,349
Average Tracks per Day													
Fishing	0.0	0.0	0.0	0.0	0.1	0.1	0.3	1.9	2.9	0.3	0.0	0.0	0.5
Transiting	0.3	0.3	0.3	0.7	1.6	2.3	2.8	3.7	2.6	0.8	0.3	0.2	1.3
All vessels	0.3	0.3	0.3	0.7	1.6	2.4	2.9	4.9	4.5	0.8	0.3	0.2	1.6
Average Days Between Tracks[a]													
Fishing	31.0	28.3	31.0	20.1	7.3	8.0	3.3	0.5	0.3	3.9	30.0	31.0	2.1
Transiting	3.2	3.4	3.0	1.5	0.6	0.4	0.4	0.3	0.4	1.3	3.0	6.0	0.8
All vessels	3.2	3.4	3.0	1.5	0.6	0.4	0.3	0.2	0.2	1.2	3.0	5.2	0.6

Source: COP Appendix III-I; Epsilon 2022a

[a] The average days between tracks is the reciprocal of average tracks per day.

The NSRA study assumes that fishing vessels typically have an overall length of 60 to 80 feet, and there are likely a number of fishing vessels less than 65 feet long (the minimum vessel length for which AIS transponders are required, per 33 CFR § 164.46) that transit through the SWDA but do not transmit AIS data. It is estimated that 40 to 60 percent of the commercial fishing fleet is represented in the AIS data. Overall, available data indicate relatively low levels of fishing effort in the SWDA (COP Appendix III-I; Epsilon 2022a). It is likely that non-AIS commercial and recreational vessels navigate through the SWDA and across the OECC. The MARIPARS completed by the USCG in 2020 considered non-AIS vessel traffic in the study but could not evaluate it extensively for the purpose of assessing navigation and use of the waterway in the wider RI/MA Lease Areas (USCG 2020). The MARIPARS found that non-AIS vessel transit tracks did not vary significantly from AIS-equipped vessels.

Raw VMS data at the individual trip level were not available for analysis in the NSRA. The current NSRA includes VMS data and histograms, shown by species and are based on the 2015 and 2016 fishing seasons (the most recent publicly available data), as provided by NMFS and BOEM. These maps supplement the AIS data by identifying areas of fishing vessel concentration within the SWDA and surrounding area. The VMS maps in the NSRA include vessel activity density, vessel speed, and targeted fisheries within the SWDA and surrounding area.[27] The directional characteristics of the overall VMS data, for all VMS fisheries combined, are consistent with the AIS data presented in this section. The vessels actively transiting follow approximate northwest-to-southeast track orientations, while those vessels actively fishing are on east-to-northeast to west-to-southwest orientations. The analysis is generally consistent with the AIS data analysis summarized in this section (COP Appendix III-I; Epsilon 2022a). Additional information on VMS data, specifically for commercial fisheries and for-hire recreational fishing, is provided in Section 3.9 and Section B.2 of Appendix B, Supplemental Information and Additional Figures and Tables.

Between 2016 and 2019, there was an annual average of 25,402 vessel crossings of the OECC (Table 3.13-3). Most of the vessel crossing traffic occurs between Martha's Vineyard and the mainland of Cape Cod. Overall, vessel traffic density along the OECC is relatively low, with the highest concentration of traffic midway through Nantucket Sound. A portion of these crossings would include regular ferries between Falmouth, Hyannis Port and other locations, and the islands of Martha's Vineyard and Nantucket. About 17.3 miles offshore, the OECC route would cross a navigation route for tug-and-barge (shown as tug-tow in Table 3.13-3), tanker, and fishing vessels. Recreational vessels have also been commonly recorded throughout this area (COP Figure 4.0-4, Appendix III-I; Epsilon 2022a). It is likely that non-AIS commercial fishing and recreational vessels navigate across the OECC. In 2019, a daily average of 71 vessels crossed the OECC (COP Appendix III-I; Epsilon 2022a).

Table 3.13-3: OECC Vessel Crossings by Type and Year (2016–2019)

Vessel Type	**2016**	**2017**	**2018**	**2019**
Fishing	10,171	10,488	9,316	9,935
Passenger	1,242	373	389	937
Cargo	66	120	81	14
Tanker	0	8	52	82
Recreational	6,106	8,137	8,366	8,412
Military	589	569	736	583
Tug-tow	602	913	832	784
Other	3,887	5,875	6,760	5,186
Total	22,663	26,483	26,532	25,933
Average Crossings per Day	**62**	**73**	**73**	**71**

Source: COP Appendix III-I; Epsilon 2022a

Available VMS data show that for trawlers smaller than 65 feet in length whose paths crossed the SWDA at some point, approximately 77 of total travel time was spent outside the SWDA, compared to 23 percent of total travel time within the SWDA (COP Appendix III-I; Epsilon 2022a). The most prevalent vessel route pattern through the SWDA is a roughly northwest-to-southeast orientation. While the area north of the SWDA is more highly frequented by commercial fishermen, the data analysis showed that the SWDA is also used by commercial fishermen engaged in activities such as transiting through the area, gillnetting, or trawling. Section 3.15 discusses recreation and tourism, while Section 3.9 discusses commercial fisheries. The heaviest vessel traffic in the SWDA vicinity occurs in four primary areas: Narragansett Bay, Buzzards Bay, Nantucket Sound, and the area between Woods Hole and Vineyard Haven. Additionally, high-volume passenger ferry traffic occurs between Hyannis and Nantucket and Martha's Vineyard. Additional information and datasets, tables, and figures related to vessel traffic can be found in

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[27] Full or part-time multispecies, scallop, monkfish, surfclam/ocean quahog, herring, mackerel, and squid/butterfish are required to have an operational VMS unit, per 50 CFR §§ 648.9–648.10.

COP Section 7.8 (Volume III; Epsilon 2022a) and in the NSRA (COP Appendix III-I, Section 6.0; Epsilon 2022a). Section 3.9 provides economic information related to commercial fisheries.

Aids to Navigation

PATON and federal aids to navigation (ATON), including radar transponders, lights, sound signals, buoys, and lighthouses, are located throughout the waters and coastlines surrounding the proposed Project area. These aids serve as a visual reference to support safe maritime navigation. The USCG operates and maintains the ATONs. There are no USCG-maintained ATONs within the SWDA or OECC. There are two PATONs within the lease area (VWM-01 and VWM-02) near the northeastern extent of the lease area but none within the SWDA. The closest buoys to the SWDA are three buoys marking the transition between Muskeget Channel and Nantucket Sound, with the nearest buoy "MC" located approximately 8.1 miles north-to-northeast from the northern boundary of the lease area. A single buoy ("1") between Nomans Island and Gay Head is approximately 167 miles northwest from the northwestern end of the lease area. The nearest PATON to the lease is a single PATON ("DMON"), which is located southwest of Nomans Land and is approximately 17.3 miles northwest from the northwestern end of the SWDA. Additional SWDA PATONs include ("154"), approximately 17.3 miles northwest from the southwestern end of the SWDA, and unnamed PATON, approximately 13.8 miles southeast from the northeastern corner of the SWDA (COP Appendix III-I, Section 6.0; Epsilon 2022a). The USCG administers the permits for PATONs on structures positioned in or near navigable waters of the U.S.

Navigational Safety

The NSRA provides USCG data for historical SAR incidents from the Vineyard Wind 1 dataset, as well as the USCG (2020) MARIPARS analysis. The Vineyard Wind 1 dataset evaluated the areas between Block Island, Rhode Island, and the SWDA—an area encompassing approximately 1,350 square miles—between June 2006 and September 2016.28 During this period, the USCG conducted 103 SAR missions in this region. Most of the reported incidents were related to equipment problems or failure (e.g., loss of engine power), medical issues, vessels taking on water, collision, capsizals, or disoriented vessels. Of the 103 reported incidents, approximately 43 percent occurred at night and 57 percent occurred during the day. Four of the reported incident cases were collisions, although none of the reported collisions were within a 11.5-mile radius of the SWDA (COP Appendix III-I; Epsilon 2022a). Collisions in or near the SWDA did not result in any deaths. Within 11.5 miles of the SWDA (inclusive of the SWDA itself), 20 incidents were reported over this 10-year period. Most were SAR missions, with some cases related to marine safety and law enforcement. Table 3.13-4 shows a breakdown of the cases by type.

Table 3.13-4: Search and Rescue and other Navigation Safety Incidents in the Southern Wind Development Area, 2006–2016

Category	Number of Incidents	Type
SAR	16	Disabled or distressed vessel
Marine safety	2	Equipment failure
Law enforcement	2	Personal conflict

Source: COP Appendix III-I, Table 7.1; Epsilon 2022a

SAR = search and rescue

Additional historical SAR data were analyzed by the USCG in the MARIPARS in the RI/MA Lease Areas vicinity for the period of 2005 through 2018 (USCG 2020). Figure 3.13-3 and 3.13-4 show the USCG SAR incidents and USCG rescue coverage areas, respectively. During this time, 133 separate

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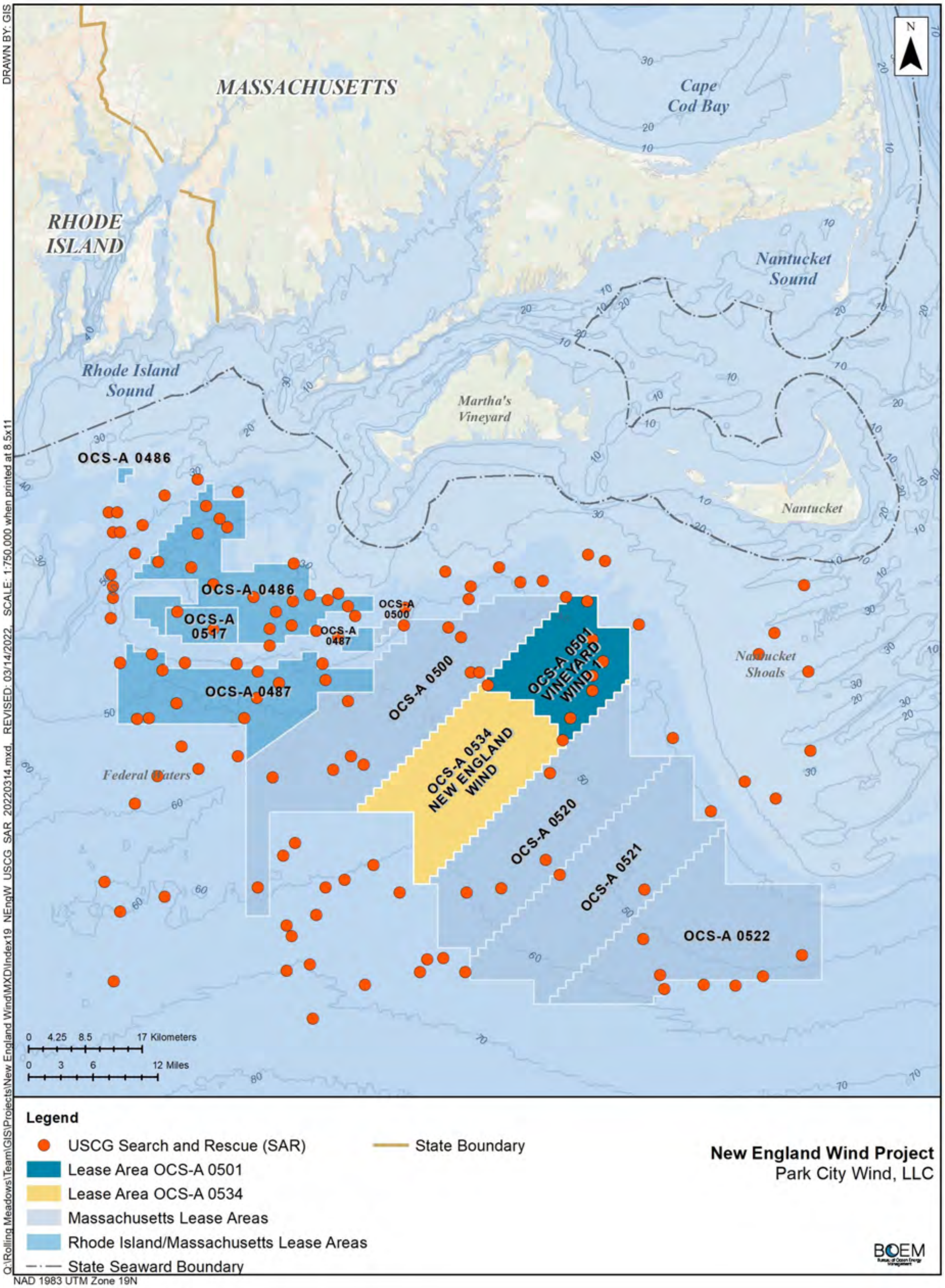
[28] A Freedom of Information Act request for more recent SAR data has been submitted to the USCG, and data covering the period from 2005 to 2020 are expected in the near future.

incidents occurred—an annual average of approximately 9.5 incidents. None of these incidents were collisions. These data exclude responding USCG assets transiting through the SWDA to reach a SAR location outside of the RI/MA Lease Areas vicinity, as well as incidents that drifted into the confines of the SWDA or SAR cases that involved towing or other transportation through the SWDA.

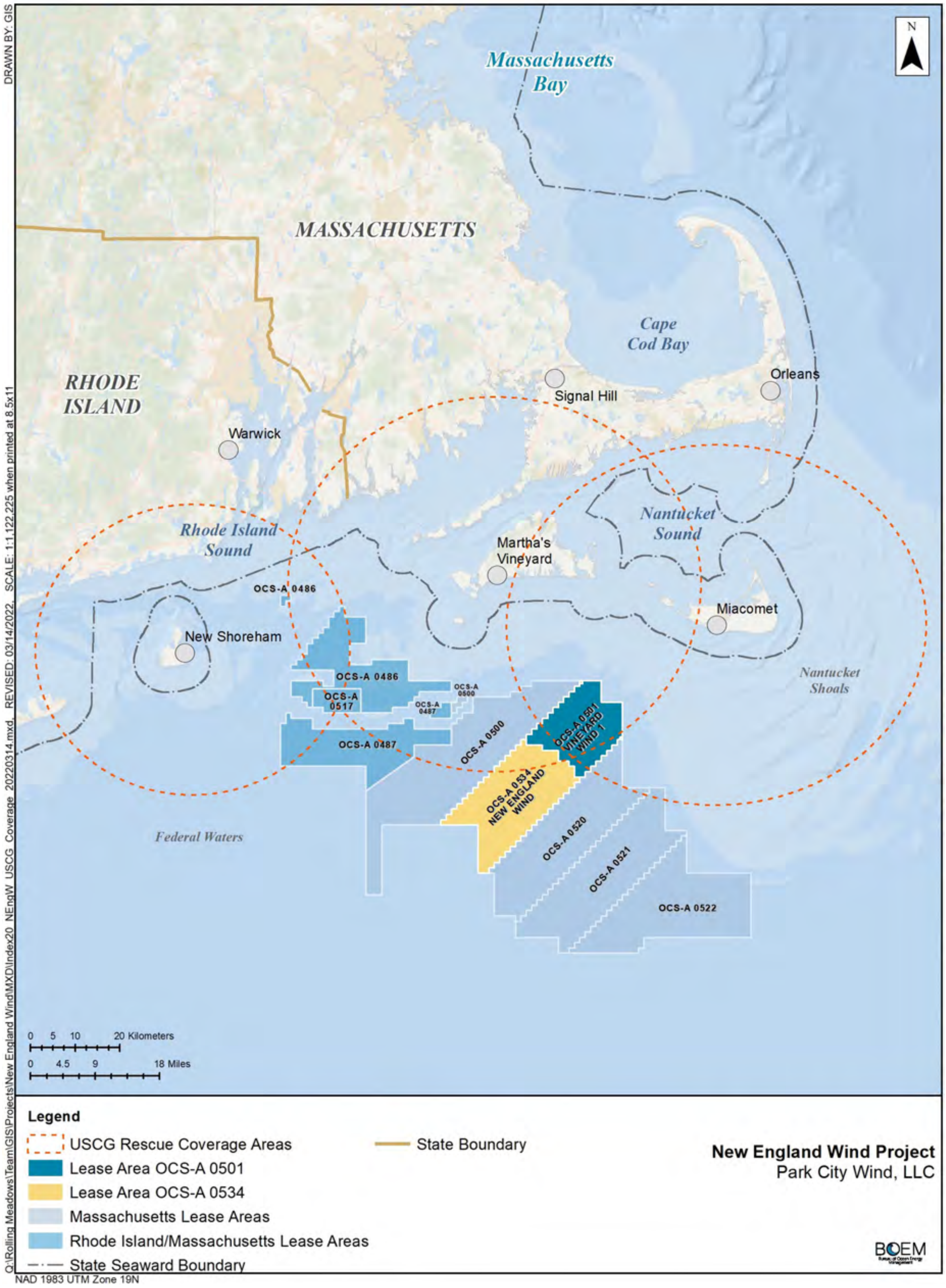
The Northeast Regional Ocean Council, the USCG First District, and marine trade associations conducted the Northeast Recreational Boater Survey in 2012 to characterize marine recreational boater activity in New England (Starbuck and Lipsky 2013). The survey collected feedback from over 12,000 owners of state-registered and federally documented vessels, including pleasure craft, commercial fishing, towing, and coastwise trade vessels in New England. According to the survey, New England boaters have an average of 30 years of boating experience, with over 65 percent of participants having previously completed navigational classes (Starbuck and Lipsky 2013). More than 58 percent of the 12,000 recreational boaters surveyed by the Northeast Regional Ocean Council stated it was “very or somewhat likely” that they could continue to enjoy recreational boating near offshore wind turbines (Starbuck and Lipsky 2013). The most common concerns identified by recreational boaters regarding allision and collision safety were “fellow boaters’ behavior,” including “inconsiderate actions by others” (74 percent), “lack of knowledge of navigation rules by others” (58 percent), and “use of alcohol by boat operators” (43 percent) (Starbuck and Lipsky 2013).

USCG’s Final MARIPARS, published in May 2020, evaluated vessel traffic through the lease areas and recommended all surface structures be aligned “along a standard and uniform grid pattern with at least three lines of orientation and standard spacing,” with north-to-south and east-to-west lanes 1.0- x 1.0-nautical-mile- (1.9-kilometer-, 1.15-mile-) wide and northwest-to-southeast or northeast-to-southwest lanes 0.6- (0.69-mile-) to 0.8-nautical-mile- (0.92-mile-) wide between structures (USCG 2020). The Final MARIPARS did not recommend implementation of any formal routing measures. The orientation of the structures within the SWDA would be placed at the recommended 1.0- × 1.0-nautical-mile (1.15- x 1.15-mile) east-to-west and north-to-south structure spacing to provide space for transiting vessels, as well as SAR and USCG assets. The structure grid pattern here is additionally aligned with the neighboring project proposals, which have also proposed 1.0- × 1.0-nautical-mile (1.15- x 1.15-mile) structure spacing.



USCG = U.S. Coast Guard

Figure 3.13-3: U.S. Coast Guard Search and Rescue Incidents



USCG = U.S. Coast Guard

Figure 3.13-4: U.S. Coast Guard Rescue Coverage Areas

Ports, Harbors, and Navigation Channels

Table 3.13-5 lists the ports that could be used for proposed Project construction, operations, and/or decommissioning. Point Judith in Washington County, Rhode Island, is also an important nearby port. These ports serve the commercial fishing industry (Section 3.9, Commercial Fisheries and For-Hire Recreational Fishing), passenger cruise lines, cargo, and other maritime activities. Of these, the largest deep draft port by volume is ProvPort (COP Volume I, Section 3.2.2.5 and 4.2.2.5; Epsilon 2022a). The primary vessel traffic to and from most of these ports and the commercial shipping lanes to these ports are outside the SWDA (COP Appendix III-I; Epsilon 2022a). However, the most common ports of transit for fishing vessels that tracked through the SWDA are New Bedford and Point Judith. Section 3.11, Demographics, Employment, and Economics, discusses economic activity at these ports.

Table 3.13-5: Port Facilities by County

County	Potential Port
Bristol County, Massachusetts	Port of New Bedford Brayton Point Commerce Center Fall River terminal facilities
Dukes County, Massachusetts	Vineyard Haven Harbor
Essex County, Massachusetts	Salem Offshore Wind Port
Fairfield County, Connecticut	Port of Bridgeport
New London County, Connecticut	Port of New London
Gloucester County, New Jersey	Paulsboro Marine Terminal
Albany County, New York	Port of Albany Beacon Island expansion Port of Coeymans
Kings County, New York	GMD Shipyard South Brooklyn Marine Terminal
Rensselaer County, New York	New York State Offshore Wind Port
Richmond County, New York	Homeport Pier Arthur Kill Terminal
Suffolk County, New York	Shoreham site Greenport Harbor
Providence County, Rhode Island	ProvPort South Quay Terminal
Washington County, Rhode Island	Port of Davisville

Source: COP Volume III; Epsilon 2022a

ProvPort = Port of Providence

The relative traffic density within the SWDA is lower than the surrounding region, with the highest transiting density through the northeast section of SWDA with the vessel traffic along a northwest-to-southeast line of orientation (COP Appendix III-I; Epsilon 2022a). Vessel traffic is concentrated between May and October, with July, August, and September having the highest vessel traffic each year. The vessel traffic varies by year, with 2016 having the highest number of unique vessels and vessel tracks, while 2018 had the lowest (Table 3.13-1). Between 2010 and 2016, cargo tonnage at area ports increased by 21.7 percent, while cargo vessel transits decreased by over 60 percent, reflecting increasing cargo vessel capacities. From 2017 to 2019, cargo tonnage at area ports decreased by 4.5 percent, while cargo vessel transits increased by over 19 percent. The decrease in cargo tonnage at area ports is likely attributed to the unavailability of 2017–2019 Hyannis Port cargo tonnage data; between 2010 and 2016, cargo tonnage at Hyannis Port made up approximately 4.2 percent of the total cargo tonnage reported for the area ports (USACE 2022a, 2022b).

Traffic patterns in the vessel traffic routes within the geographic analysis area are relatively stable; however, vessel size and vessel traffic volume and density in the geographic analysis area could be affected by coastal developments, market demands, and other factors (Northeast Regional Ocean Council 2022). In general, large non-fishing commercial vessels do not frequently transit through the SWDA;

most of these vessels transit along the marked fairways and channels. However, 2016 to 2020 AIS maps indicate that a substantial volume of sailing, fishing, and other vessels traverse this area (COP Appendix III-I; Epsilon 2022a; Northeast Regional Ocean Council 2022).

3.13.2 Environmental Consequences

Definitions of potential impact levels for navigation and vessel traffic are provided in Table 3.13-6. There are no beneficial impacts on navigation and vessel traffic.

Table 3.13-6: Impact Level Definitions for Navigation and Vessel Traffic

Impact Level	Definition
Negligible	Impacts would be so small as to be unmeasurable.
Minor	Impacts would be avoided. Normal or routine functions associated with vessel navigation would not be disrupted.
Moderate	Impacts would be unavoidable. Vessel traffic would have to adjust somewhat to account for disruptions due to impacts of the Project.
Major	Vessel traffic would experience unavoidable disruptions to a degree beyond what is normally acceptable, including potential loss of vessels and life.

3.13.2.1 Impacts of Alternative A – No Action Alternative on Navigation and Vessel Traffic

When analyzing the impacts of Alternative A on navigation and vessel traffic, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on existing conditions for navigation and vessel traffic (Table G.1-10 in Appendix G). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for navigation and vessel traffic described in Section 3.13.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on navigation and vessel traffic would continue to follow current regional trends and respond to current and future environmental and societal activities.

While the proposed Project would not be built under Alternative A, ongoing activities, future non-offshore wind activities, and future offshore wind activities would have continuing short- and long-term impacts on existing navigation and vessel traffic, primarily through the presence of structures, port utilization, and additive proposed Project-related vessel traffic. The impacts of ongoing activities, especially presence of structures, port utilization, and vessel traffic, would be **moderate**. Seafloor areas within the SWDA and OECC route would remain available for future marine minerals leasing, location of future offshore energy projects, siting of future submarine cables and pipelines, and surface or submarine military vessel activity. The harbors proposed for construction, operations, or decommissioning would continue current operations. In addition to ongoing activities, planned activities other than offshore wind may also contribute to impacts on navigation and vessel traffic. Planned activities other than offshore wind include anchoring and gear utilization, port expansion, cable emplacement and maintenance, and SAR operations (Table G.1-17). The impacts of planned activities other than offshore wind would be **negligible**. The combination of ongoing and planned activities would result in **moderate** impacts on navigation and vessel traffic.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on navigation and vessel traffic include continued operation of the Block Island Wind Farm and ongoing construction of Vineyard Wind 1 in OCS-A 0501 and the South Fork Wind Project in OCS-A 0517. Ongoing operations of the Block Island Wind Farm and ongoing construction of Vineyard Wind 1 and

South Fork Wind Projects along with planned offshore wind activities, would affect environmental justice through the primary IPFs described below.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than Alternative B). Future offshore wind activities would affect navigation and vessel traffic through the following primary IPFs.

Anchoring and gear utilization: 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 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 could result in damage to the export cable, risks associated with an anchor contacting an electrified cable, and impacts on the vessel operator’s liability and insurance. Impacts on navigation and vessel traffic would be temporary and localized, and navigation and vessel traffic would fully recover following the disturbance. In total, BOEM estimates approximately 126 acres of seabed would be disturbed by anchoring associated with offshore wind activities. Considering the small size of the geographic analysis 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 anchoring associated with offshore wind activities would affect navigation and vessel traffic.

Other planned activities in the geographic analysis area could contribute to anchoring and gear utilization impacts. Larger commercial vessels (specifically tankers) sometimes anchor outside major ports to transfer their cargo to smaller vessels for transport into port. 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. All vessels may anchor if they lose power to prevent them from drifting and creating navigational hazards for other vessels or for drifting into structures. Ongoing activities and future non-offshore wind activities would contribute similar impacts, especially along the routes of potential cables, perhaps connecting Martha’s Vineyard and/or Nantucket to the mainland.

Anchoring from activities other than offshore wind (i.e., commercial and recreational vessels) would continue. The decommissioning and removal of structures associated with future offshore wind projects would have the same impacts on anchoring and gear utilization as those described for construction.

Cable emplacement and maintenance: Based on the assumptions in Table E-1 in Appendix E, the 1,044 foundations (WTGs and ESPs) would require approximately 2,576 miles of inter-array and inter-link cables within the geographic analysis area for navigation and vessel traffic. 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 specifically add slower-moving vessel traffic above cable routes. Vessels not involved in cable emplacement or maintenance would need to take additional care when crossing cable routes during construction and operations activities. There would likely be simultaneous cable-laying activities from multiple projects based on the estimated construction timeline. As described in Appendix E, OECC, inter-array, and inter-link cables for up to seven offshore wind projects (including the proposed Project) could be under construction simultaneously in 2025. Concurrent construction of necessary cable infrastructure for other offshore wind projects could have a cumulative impact; however, it is assumed that vessels required for installation would only be present over a portion of the proposed Project's inter-array/inter-link system at any given time. While segments of some OECC routes for these projects would overlap each other geographically (including at least one crossing of the OECCs for the proposed Project and Mayflower Wind), large areas of open ocean would separate most OECCs, even if simultaneously constructed. Construction of inter-array and inter-link cables would not overlap. While simultaneous cable-laying activities may disrupt vessel traffic over a larger area than if activities occurred sequentially, the total time of disruption would be less than if each project were to conduct cable-laying activities sequentially.

Operations of future offshore wind projects could result in additional risks for anchor strikes; however, utilization of mattress protection and achieving burial depths of inter-array, inter-link, and offshore export cables would reduce the impact of emergency or accidental anchor deployment and not preclude the use of the area by commercial fishing operations, recreation vessels, or transportation vessels. The decommissioning of future projects and removal of underwater infrastructure would decrease the instances and impacts of an emergency or accidental anchor deployment and have the same impacts as construction.

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, operations) 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. Based on the vessel traffic generated by the proposed Project, BOEM assumes that construction of each future offshore wind project would generate an average of 22 and a maximum of 56 vessels operating in the geographic analysis area (per phase) for navigation and vessel traffic at any given time, and that each future offshore wind project would generate a daily average of 15 vessel trips during peak construction (COP Volume I; Epsilon 2022a). Up to six offshore wind projects (not including the proposed Project) would be under construction at the same time in 2025. During this peak period, Alternative A would result in 132 to 336 vessels operating simultaneously, generating up to 90 vessel trips per project per day to and from ports in the region (assuming overlap of the peak construction periods of all six simultaneous projects). Fewer vessels would be present, and fewer trips would occur during other parts of the overall construction period (2022 to 2030) for offshore wind projects in the RI/MA Lease Areas. The increase in port utilization due to this vessel activity would vary across ports and 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. Other offshore wind projects would likely use a variety of operations ports; therefore, the total increase in vessel traffic would likely be distributed across multiple ports within and outside of the geographic analysis area. Delays for vessels using those ports could occur if two or more projects use the same port for operations activities. The decommissioning and removal of export cables from the SWDA and the OECC would have similar impacts on port utilization as construction.

Presence of structures: Using the assumptions in Appendix E, Alternative A would include approximately 913 WTGs and ESPs (excluding the proposed Project) 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 presence of WTG and ESP structures in areas where no such structures currently exist, potential compression of vessel traffic both outside and within wind development areas, potential interference with marine vessel radars (MVR) (although other navigation tools are available to ship captains), and potential difficulty seeing other vessels due to a cluttered view field. Under certain atmospheric conditions, wind energy facilities could contribute to fog formation (Hasager et al. 2017).

A study by the University of Texas (Ling et al. 2013) used modeling (but not studies of operational offshore wind facilities) to simulate the electromagnetic scattering and propagation over ocean surfaces to provide a baseline evaluation of simulated electromagnetic and acoustical challenges to sea surface, subsurface, and airborne electronic systems presented by offshore wind energy facilities. This study indicated a potential for MVR interference from offshore wind turbines. Specifically, using modeling, Ling et al. (2013) concluded that:

- Communications systems in the marine environment are unlikely to experience interference as the result of typical offshore wind development configurations, except under extreme proximity or operating conditions;
- MVR and ocean monitoring high frequency sensors may experience interference under certain proximity and operating conditions as the result of typical offshore wind development configurations;
- Sensitive airborne radars may experience serious interference; however, the degree of interference may be system-specific and dependent on whether offshore wind developments are located within the operational area of the radar; and
- Due to the virtual absence of noise exceeding background levels radiated underwater by wind turbines at frequencies above 1 kHz, interference with underwater acoustical systems is deemed to be unlikely at such frequencies. At frequencies below 1 kHz, the tones radiated by wind turbines may cause interference with certain acoustical systems when placed near a wind development.

A 2022 National Academies of Sciences, Engineering, and Medicine (NAS) study found adverse impacts on MVR from offshore WTGs (NAS 2022). Specifically, the study found that offshore WTGs affect MVR in some situations, most commonly through a substantial increase in strong reflected energy cluttering the operator’s display, leading to complications in navigation decision-making (NAS 2022). The sizes of anticipated offshore WTGs and projects would exacerbate these impacts (NAS 2022). This decreased efficacy applies to both traditional, magnetron-based MVRs and as-fielded, solid-state MVRs. Degraded effectiveness of MVR could lead to lost contact with smaller objects, such as recreational vessels and buoys (NAS 2022).

MVR have varying capabilities, and the ability of radar equipment to properly detect objects is dependent on radar type, equipment placement, and operator proficiency. General mitigation and monitoring measures such as properly trained radar operators, properly installed and adjusted vessel equipment, marked wind turbines, and the use of AIS all would enable safe navigation with minimal loss of radar detection (USCG 2020). The NAS study also found that WTG-related MVR interference could be lessened through improved radar signal processing and display logic or signature-enhancing reflectors on small vessels to minimize lost contacts.

As stated in Section E.3.1 in Appendix E, developers of all offshore wind projects in the RI/MA Lease Areas have agreed to install WTGs and ESPs in an aligned 1.0-nautical-mile (1.15-mile) × 1.0-nautical-mile (1.15-mile) grid within 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 operations 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. Decommissioning impacts would be similar to construction impacts.

Potential impacts of these conflicts include increased risk of allisions with stationary structures or vessels and collisions with other vessels; 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.

Structures from other offshore wind activities would generate comparable impacts across the entire RI/MA Lease Areas, with the extent of coverage increasing as additional offshore wind projects are constructed. Large vessels headed to or from Boston or New York City that occasionally transit through the SWDA would also need to adjust course to avoid the proposed Project and other planned activities. The presence of neighboring wind energy leases would further increase the navigational complexity in the region, resulting in an increased risk of collisions and allisions, which could result in personal injury or loss of life from a marine casualty, damage to boats or turbines, and oil spills. The presence of neighboring wind energy leases could also affect demand for and resources associated with USCG SAR operations by changing vessel traffic patterns and densities in the larger RI/MA Lease Areas. Additionally, the USCG would need to adjust its SAR planning and search patterns to allow aircraft to fly within the geographic analysis area, leading to a less-optimized search pattern and a lower probability of success.

The fish aggregation and reef effect 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 3.7, Marine Mammals, 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 the SWDA. Overall, the impacts of this IPF on navigation and vessel traffic would be long term (as long as structures remain), regional (throughout the entire geographic analysis area for navigation and vessel traffic), and continuous.

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 22 and a maximum of 56 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) would overlap with offshore wind-related vessel activity in the open ocean and near ports supporting the offshore wind projects. The impacts of operations-related vessel traffic in and adjacent to the RI/MA Lease Areas could be reduced through a shared operational strategy. As shown in Table E-1 in Appendix E, this increase in vessel traffic and navigation risk would be at its peak in 2025, when up to 841 WTGs and ESPs (out of the 913 total in the RI/MA Lease Areas) associated with at least six offshore wind projects (other than the proposed Project) would be under simultaneous construction—i.e., a total of approximately 132 to 336 vessels in the geographic analysis area for navigation and vessel traffic at any given time during peak construction. Because the ports to be used by other offshore wind projects have not been determined, the overlap of vessel activity at any single port cannot be predicted. Traffic from these projects would likely be spread among multiple ports within and outside the geographic analysis area for navigation and vessel traffic, thus potentially reducing the impact of offshore wind-related vessel traffic at any single location. This increased offshore wind-related vessel traffic during construction would have short-term, continuous, localized impacts on overall (wind and non-wind) navigation and vessel traffic. These impacts incorporate the increased engagement of SAR and reduced likelihood of SAR success. Impacts on SAR activities themselves are discussed in Section 3.14.

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 (COP Volume I, Figures 3.1-3 and 4.1-3; Epsilon 2022a), with corrective maintenance as needed. Based on information for the proposed Project (COP Volume I; Epsilon 2022a), approximately 250 vessel round trips per offshore wind project—totaling 2,250 vessel trips per year or an average of about 6 vessel trips per day, excluding the proposed Project—are estimated to take place annually during operations of Alternative A. 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.

Conclusions

Impacts of Alternative A. Under Alternative A, conditions for navigation and vessel traffic would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on navigation and vessel traffic would continue to follow current regional trends and respond to current and future environmental and societal activities. While the proposed Project would not be built under Alternative A, ongoing activities would have continuing short- and long-term impacts on existing navigation and vessel traffic, primarily through the presence of structures, port utilization, and additive proposed Project-related vessel traffic. The impacts of ongoing activities, especially presence of structures, port utilization, and vessel traffic, on navigation and vessel traffic would be **moderate**.

Cumulative Impacts of Alternative A. In addition to ongoing activities, planned activities may also contribute to impacts on navigation and vessel traffic. Considering all the IPFs together, ongoing and planned activities in the geographic analysis area would result in **moderate** cumulative impacts on navigation and vessel traffic. 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, and an increased likelihood of collisions and allisions, with resultant increased risk of accidental releases. Under the assumptions in Appendix E, Alternative A would include approximately 1,044 WTGs and ESPs in the geographic analysis area for navigation and vessel traffic in areas where no such structures currently exist. This would increase the risk for collisions, allisions, and resultant accidental releases and threats to human health and safety.

3.13.2.2 Relevant Design Parameters and Potential Variances in Impacts

The following proposed Project design parameters (Appendix C, Project Design Envelope and Maximum-Case Scenario) would influence the magnitude of the impacts on navigation and vessel traffic:

- The length, route(s), and final width of OECC, inter-array, and inter-link cable routes.
- As described in Section 2.1, Alternatives Analyzed in Detail, the final geographic size of Vineyard Wind 1 would define the northeastern border of Phase 1 of the proposed Project. As a result, the potential footprint of Phase 1 includes a portion of Lease Area OCS-A 0501, as well as portions of Lease Area OCS-1 0534 (Figure 2.1-2). If Vineyard Wind 1 uses its maximum number of spare positions, Phase 1 would be located farther southwest than if Vineyard Wind 1 were to use fewer spare positions.
- Phase 1 could include 50 to 62 WTGs depending on WTGs’ electrical capacity (i.e., between 13 to 16 MW). The capacity of WTGs selected for Phase 1 would depend on the feasibility and commercial availability of WTGs to meet the Phase 1 construction schedule. WTGs with higher generating capacities would result in a smaller footprint, while lower generating capacities would result in a larger footprint. To account for the range in the number of WTGs that may be developed for Phase 1, the potential footprint of Phase 1 overlaps with the potential footprint of Phase 2.
- Engineering and environmental constraints could eliminate positions, thereby extending the Phase 1 footprint farther southwest.
- Selection of the Western Muskeget Variant for Phase 2 would affect a different portion of the Muskeget Channel than the proposed (eastern) route.

- Selection of the SCV for Phase 2 would include an additional OECC, cable landing site, OECR, and substation that would carry a portion of Phase 2 electricity to a grid interconnection point in Bristol County, Massachusetts (Figure 2.1-7). If the SCV is necessary, the OECR and OECC through state waters would be evaluated in a supplemental NEPA analysis.
- The timing of proposed Project construction and variability in regional port utilization may result in uncertainty regarding which ports may be available during Phase 1 and Phase 2. It is not expected that all the ports identified would be used; it is more likely that only some ports would be used during construction depending upon final construction logistics planning.
- Decommissioning procedures and co-occurring decommissioning efforts of multiple projects.

3.13.2.3 Impacts of Alternative B – Proposed Action on Navigation and Vessel Traffic

This section identifies potential impacts of Alternative B on navigation and vessel traffic.

Impacts of Phase 1

Phase 1 would affect navigation and vessel traffic through the following primary IPFs during construction, operations, and decommissioning.

Anchoring and gear utilization: Phase 1 would 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. As a result, anchoring and gear utilization during Phase 1 construction would have **negligible** impacts on navigation and vessel traffic. 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 on the vessel operator’s liability and insurance. Larger vessels concerned with the export cable are not expected to pass over the cable area, transiting instead farther west and south. For smaller commercial or recreational vessels, the risks would be the same as for all offshore wind installations, except only over the 306 acres of hard cover and scour protection over foundations and cables.

The operations stage of Phase 1 would not impede vessels anchoring within the SWDA other than near the presence of the WTGs and ESPs (and associated scour protection) and limited placement of cable protection (estimated to occur along no more than 2 percent of the offshore cables within the SWDA). The proposed WTG and ESP spacing allows ample space for emergency anchoring of vessels between the structures, including allowance for an anchor sweep radius. All inter-array, inter-link, and offshore export cables within the proposed Project area and SWDA would be buried beneath the seafloor at a target depth of 5 to 8 feet. The target burial depth is more than twice the burial depth required to protect the cables from fishing activities and provides a maximum of 1 in 100,000-year probability of anchor strike, which is considered a negligible risk (COP Appendix III-I; Epsilon 2022a). This abundance of caution would limit the impacts on accidental or emergency anchor deployment and reduce the likelihood of operational disruption or damage. The operational impacts on anchoring and gear utilization are localized, long term, and **negligible**. The decommissioning and removal of export cables from the SWDA and the OECC would have similar impacts on anchoring and gear utilization as construction. The removal of underwater infrastructure and components would decrease the instances of emergency scenarios requiring larger vessels to deploy anchors and potentially damage WTG/ESP or export cables. The risk of 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 be removed, and smaller commercial or recreational vessels would no longer need to avoid or exercise caution over the areas of hard cover and scour protection over foundations and cables.

Cable emplacement and maintenance: Outside the SWDA, the Phase 1 cables would be installed within a portion of the approximately 3,100- to 5,100-foot-wide shared OECC.[29] The Phase 1 offshore export cables are expected to be located west of the Vineyard Wind 1 offshore export cables. To provide appropriate flexibility for routing and installation and allow room for maintenance or repairs, the Phase 1 cables would typically be separated from each other and the Vineyard Wind 1 cables by 164 and 328 feet, although this distance could be further adjusted pending ongoing routing evaluation (COP Volume I, Section 3.1.3; Epsilon 2022a). An average of approximately four vessels may be used for cable-laying activities with up to approximately seven vessels during the peak months of activity (COP Appendix III-I; Epsilon 2022a). The offshore export cables would likely be transported directly to the SWDA in a cable-laying vessel, on an ocean-going barge, or on a heavy transport vessel (which may also transport the cable-laying vessel overseas) and installed by the cable-laying vessel upon arrival. Phase 1 construction would restrict vessel movement in the SWDA and OECC and require the presence of large and oversized slow-moving (or stationary) installation or maintenance vessels, which would increase the risk of collisions. Typical cable installation speeds are expected to range from 5.5 to 11 feet per minute, and it is expected that offshore export cable installation activities would occur 24 hours per day. Once offshore export cable installation has begun, to preserve the integrity of the cable, installation would ideally be performed as a continuous action along the entire cable alignment between splices (COP Volume I, Section 3.3.1.3.6; Epsilon 2022a). This would lead to incrementally increased congestion and navigational complexity within the SWDA, 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 SWDA. However, by utilizing a shared OECC, Phase 1 would leverage the existing survey work already performed for Vineyard Wind 1, thus reducing survey vessel activity and associated health and safety risks (COP Volume I, Section 2.3; Epsilon 2022a). Overall, Phase 1 cable installation would have localized, short-term, intermittent, and **minor** impacts on navigation and vessel traffic.

The operation of new submarine cables within the SWDA and along the OECC is not anticipated to preclude vessel activities. As stated for the anchoring and gear utilization IPF, the target burial depth for all inter-array, inter-link, and offshore export is more than twice the burial depth that is required to protect the cables from fishing activities and provides a maximum of 1 in 100,000-year probability of anchor strike, which is considered a negligible risk (COP Volume III, Section 9.10; Epsilon 2022a). Except for limited areas where sufficient cable burial is not achieved and use of cable protection is required, the inter-array, inter-link, and offshore export cables would not interfere with any typical fishing practices, recreational activities, or transit. These impacts would be localized, long term, and **negligible**.

During decommissioning and removal of cables, an average of approximately four vessels may be used for cable removal activities with up to approximately seven vessels during the peak months of activity (COP Appendix III-I; Epsilon 2022a). Phase 1 would, therefore, result in restricted vessel movement in the SWDA and OECC during decommissioning and cable removal activities. As with the construction stage, this would lead to increased congestion, space conflicts, and navigational complexity within the SWDA and would result in localized, short-term, intermittent, and **negligible** impacts on navigation and vessel traffic.

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[29] Where the OECC travels through Lease Area OCS-A 0501, the width of the corridor may be narrower than 3,100 feet to avoid possible interference with Vineyard Wind 1’s offshore facilities.

Port utilization: Phase 1 construction would produce vessel traffic at multiple ports (Table 3.13-7). The largest number of trips is expected between the SWDA and either New Bedford Harbor or some combination of Bridgeport, Vineyard Haven, Davisville, or South Quay Terminal, with an average of 7 to 8 round trips per day and up to 15 round trips per day during the peak of construction activity, although the estimates of vessel traffic are speculative and contingent on construction schedule and supply chain factors. The Port of New Bedford houses over 300 fishing vessels and receives more than 500 large commercial vessel calls each year. Several ferry services operate from the port, including fast ferries to the islands of Martha's Vineyard and Nantucket. The harbor is protected by a large hurricane barrier (breakwater) that has storm surge gates across the entrance channel. The channel has a width of 150 feet at this location, which is the controlling width for entrance of ships. An analysis of AIS data was conducted for New Bedford Bay (COP Appendix III-I, Table 10.1; Epsilon 2022a). An average of 8 vessel round trips per day (or an equivalent 16 transits per day) is expected during Phase 1 construction, as compared to an existing average of 45 transits per day for AIS-equipped vessels. Peak traffic typically occurs in July and August, with an existing average of 86 daily transits. The actual total number of existing transits may be significantly higher, possibly by a factor of two or three, due to the numerous smaller vessels that do not utilize AIS (COP Appendix III-I, Section 10.3, and Table 10; Epsilon 2022a).

Table 3.13-7: Phase 1 Port Utilization

Port	Average Round Trips Per day	
	Peak Construction Activity	Average for Construction Phase
New Bedford, Massachusetts	15	8
Bridgeport, Connecticut Vineyard Haven, Massachusetts Davisville, Rhode Island South Quay Terminal, Rhode Island	15	7
Providence, Rhode Island Brayton Point Commerce Center, Massachusetts Fall River, Massachusetts New London State Pier, Connecticut Staten Island, New York South Brooklyn Marine Terminal GMD Shipyard, New York Shoreham Terminal, New York	13	6
Salem Harbor, Massachusetts	2	1
Port of Albany, Port of Coeymans, New York Paulsboro Marine Terminal, New Jersey	1	1

Source: COP Appendix III-I, Table 2.7; Epsilon 2022a

Phase 1 would generate trips by various methods, including specialized equipment vessels (scour protection installation, survey, jack-up heavy lift, and transport vessels), crew transport vessels (crew change, accommodation vessels), and support vessels (tugboat and barge). Construction of Phase 1 would generate an average of 22 and a maximum of 56 vessels operating in the SWDA or over the OECC route at any given time (COP Volume I, Section 3.3.1.12.1; Epsilon 2022a). Many construction vessels would remain at the SWDA or OECC for days or weeks at a time, potentially making infrequent trips to port for bunkering and provisioning as needed. Therefore, although an average of approximately 22 vessels would be present in the SWDA during construction of each phase, fewer vessels would transit to and from port each day.

For the maximum design scenario of Phase 1, approximately 3,000 total vessel round trips are expected during the offshore construction period, which equates to an approximate average of 6 vessel round trips per day under an 18-month offshore construction schedule for Phase 1. During the most active month of construction, it is anticipated that an average of approximately 15 daily vessel round trips could occur (COP Volume I; Epsilon 2022a). Overall, it is anticipated that there would be a noticeable increase in the number of large vessels transiting into and out of New Bedford Harbor during construction. This would correspond to less than a 10 percent increase in total transits at the harbor and is within the level of day-to-day variability in number of transits. The increased transits are not expected to result in significant delays or congestion, although movements through the hurricane barrier would need to be carefully managed (COP Appendix III-I, Section 10.3, and Table 10; Epsilon 2022a). Near port facilities or adjacent waterways, Phase 1 vessels may require other vessels transiting navigation channels or other areas of confined navigation (e.g., the New Bedford hurricane barrier) to adjust course, where possible, or adjust their departure/arrival times to avoid navigational conflicts (COP Volume III, Table 7.8-3; Epsilon 2022a). The presence of large, specialized equipment vessels and support vessels could cause delays for vessels not associated with Phase 1 and produce a change in the port utilization and routes used by fishing or recreational vessel operators.

For Phase 1 operations, the applicant would likely establish a long-term SOV operations base at Barnum Landing in Bridgeport, Connecticut (COP Volume I, Section 3.2.2.6; Epsilon 2022a). The SOV operations base would be the primary homeport for the SOV and likely be used for crew exchange, bunkering, spare part storage, and load-out of spares to the SOV and/or other vessels. In addition to the SOV operations base, the applicant may base some Phase 1 operations activities on Martha’s Vineyard. Phase 1 vessels would primarily travel between the operations facilities (likely located in Bridgeport, Vineyard Haven, and/or New Bedford Harbor) and the SWDA. During typical Phase 1 operations, an average of approximately six vessels would operate at the SWDA or along the OECC on any given day. In other maintenance or repair scenarios, up to approximately 14 vessels could operate within the SWDA or along the OECC at one time. Emergencies and corrective maintenance scenarios create a level of unpredictability in the estimated number of vessel trips and the associated level of disruption. Approximately 470 vessel round trips would take place annually during the simultaneous operations of Phase 1 and 2, which equates to an average of less than 2 vessel round trips per day. The SWDA is not heavily trafficked, and vessel activities during operations would not significantly affect the limited vessel traffic occurring within the SWDA (COP Appendix III-I; Epsilon 2022a). Additionally, regular maintenance activities would occur in the OECC infrequently, primarily to conduct inspections of the offshore export cables on a scheduled maintenance timetable (COP Volume I, Sections 3.3.2 and 4.3.2; Epsilon 2022a). The vessels used for such inspections are similar in size and operational requirements to other vessels frequently operating in the RI/MA Lease Areas and would likely not generate congestion, maneuverability limitations, or reductions in available space while transiting or returning to port. Therefore, few impacts on existing vessel traffic, including passenger vessel traffic, are anticipated from operations activities in the SWDA and along the OECC. Because an average of fewer than two operations vessels would transit to and/or from the operations facility on any given day, vessel activities at the operations facility are not expected to affect other commercial or recreational vessel traffic (COP Volume III, Section 7.8.2.2.1; Epsilon 2022a). As a result, Phase 1 operations would have localized, long-term, continuous, and **minor** impacts on port utilization and availability.

Once the Phase 1 operational terms end, the facilities would be decommissioned by retiring in place or removing cable systems, dismantling and removing WTGs, ESPs, foundations, and scour protection. This process is essentially the reverse of construction and would require similar numbers and sizes of vessels (COP Volume III, Section 7.8.2.3; Epsilon 2022a). The decommissioning and removal of export cables from the SWDA and the OECC would, therefore, have similar impacts on port utilization as construction: short term, continuous, and **moderate**.

Presence of structures: The presence of 50 to 62 WTGs and 1 to 2 ESPs partially or nearly constructed or installed would place obstacles in locations where there are currently none, thus increasing the chance of vessel allision with structures or vessels providing support. Phase 1 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 potentially vessel fuel spills. However, the layout of Phase 1 (WTGs oriented in an east-to-west and north-to-south grid pattern with

1.0- x 1.0-nautical-mile (1.15- x 1.15-mile) spacing and diagonal lines of orientation in the northwest-to-southeast and southwest-northeast directions with a spacing of 0.7 nautical mile [0.8 mile]) would create predictable grid-like organization and likely would not complicate SAR activities (COP Appendix III-I; Epsilon 2022a). Per the USCG's (2020) MARIPARS, "SAR capabilities in the WEA [wind energy area] will be impacted by the presence of structures in the ocean where before there were no such structures;" however, the presence of Phase 1 construction vessels and partially constructed foundations and structures are not expected to significantly affect SAR operations in the SWDA and may facilitate operations, as partially constructed structures would be marked and lighted, and construction vessels would continuously be within the SWDA (COP Appendix III-I; Epsilon 2022a).

The presence of WTGs (both completed and partially constructed) would affect MVR systems, including the potential for disruptions in radar imagery and clutter on operator screens. In particular, the 2022 NAS study found that offshore WTGs could lead to cluttered MVR images and more complex navigation. Increased vessel traffic due to Phase 1 construction activities would have little to no impact on the successful operation of marine radar systems (COP Volume III, Section 7.8.2.1.3, and Appendix III-I; Epsilon 2022a). Provided vessels would not be navigating through the safety zones around working areas, these potential impacts would only occur in the portion of the turbine field already or partially constructed. Overall, the presence of structures during Phase 1 construction would have localized, long-term, continuous, and **moderate** impacts on navigation and vessel traffic.

Phase 1 would include up to 63 potential new structures with which vessels could allide. The Navigational and Operational Risk Model (NORM) for operations of both phases of Alternative B quantifies navigational risk for open water and defined waterway conditions and can calculate the occurrence frequency of vessel grounding, head-on collisions, overtaking collisions, crossing collisions, powered allisions, and drifting allisions (COP Appendix III-I; Epsilon 2022a). The NORM estimated a small increase in accident frequencies associated with construction of WTGs and ESPs throughout the SWDA (Phase 1 and Phase 2 considered together), with a 0.061 annual frequency pre-construction changing to 0.078 to 0.080 annual frequency during operations. This represents an additional vessel collision once every 53 to 59 years on average and is considered a small change in risk. The increase in overall risk associated with the SWDA is approximately 0.011 additional accidents per year, or one additional accident every 82 years, which is also considered a small change in risk. For reference, Table 3.13-8 shows estimated number of collisions per year and estimated average number of years between collisions under existing (pre-construction) conditions. Much of this risk is associated with the Phase 1 and Phase 2 operations vessels. The risk associated with these operations vessels may be slightly over-estimated in the NORM because these vessels would generally transit during fair weather conditions, whereas the NORM does not distinguish among weather conditions. The overall risk of allision is small with average recurrence intervals for all classes of vessels in the range approximately of 491 to 1,135 years. Of the allisions, much of the risk was associated with drifting allisions. A powered allision is considered of very low probability. The causation probability for collisions and powered allisions (i.e., essentially the probability that human error will occur) was unchanged between the existing and future cases in the model. Table 3.13-9 shows estimated accident frequency during Phase 1 operations, including the change in frequency attributable to Phase 1. Based on the above, the navigational risks and hazards from allision based on the presence of structures would have long-term, continuous, and **moderate** impacts.

The presence of structures would restrict movement and could potentially compound space use conflicts with WTGs/ESPs and operations vessels, which would require an increase in operator vigilance and awareness. The presence of structures, where there were previously none, would lead to increased congestion and navigational complexity within the SWDA through factors such as turn radius limitations and crew fatigue, which could lead to increased risk of damage to vessels, injury to crews, engagement of

USCG SAR, and vessel fuel spills. The navigational risks and hazards associated with the operations of Phase 1 would have long-term, continuous, and **moderate** impacts.

Table 3.13-8: Estimated Existing Collision Frequency

Vessel Class	Annual Collision Frequency[a] (collisions per year)	Average Years Between Collisions[b]
All	0.061	16
Cargo	0.0013	759
Tanker	0.00081	1238
Passenger	0.00036	2752
Military	0.00006	17,829
Fishing- trawling	0.029	34
Fishing- transiting	0.024	42
Recreation	0.0053	190
Tug-tow	0.00011	9,415

Source: COP Appendix III-I, Table 9.9, and Table 9.10; Epsilon 2022a

[a] These values are also referred to as the pre-construction inter-class collision annual frequencies.

[b] The average number of years between collisions is also referred to as the average recurrence interval.

Due to WTG spacing and minimum blade tip clearance above the ocean surface, USCG marine assets could safely navigate and maneuver within the SWDA; therefore, Phase 1 operations would not affect USCG marine operations (for SAR or other purposes). Disruptions to the operation of emergency transponder systems, used by many ocean-going vessels, would likely not be affected by SAR response or SAR aviation presence in the area. USCG aviation assets would not be affected by Phase 1, except for missions directly within the SWDA, where aviation assets would need to maneuver around WTGs and ESPs. USCG SAR pilots recommend a minimum spacing of 1.0 nautical mile (1.15 miles) between WTGs for search paths to enable aviation assets to safely navigate (USCG 2020). Helicopter operations for USCG SAR missions typically travel at speeds of 70 to 90 knots and can turn with a diameter from 0.9 to 1.2 miles at these speeds. The 1.0- x 1.0-nautical-mile (1.15- x 1.15-mile) spacing of the WTGs is considered adequate for the maneuverability of USCG aviation assets within the SWDA (USCG 2020). Notwithstanding the above, the gridded layout of Phase 1 could complicate SAR activities during operations and lead to abandoned SAR missions and resultant increased fatalities. This would have regional, long-term, continuous, and **moderate** impacts on navigation and vessel traffic.

The presence of WTGs would affect marine radar systems, including potential disruptions in radar imagery and clutter on operator screens. The MARIPARS noted that the potential for interference with marine radar is site-specific and dependent on many factors, such as turbine size, array layouts, number of turbines, construction material(s), and vessel types. The 2022 NAS study found that offshore WTGs could lead to cluttered MVR images and more complex navigation, though other navigational aids are available. Impacts on marine radar systems and SAR capabilities would, therefore, be long term, regional, and **minor** on navigation and vessel traffic.

Table 3.13-9: Estimated Accident Frequency during Phase 1 Operations

Vessel Class	Structure	Annual Incident Frequency, Phase 1[a]			Existing Accident Frequency[b]	Change in Accident Frequency (%)	Average Years Between Incidents, Phase 1[c]			Average Years Between Incidents, Existing[b]	Change in Years Between Accidents (%)
		Collisions	Allisions	All Incidents			Collisions	Allisions	All Incidents		
All	Monopile	0.078	0.00088	0.078	0.061	22%	12.9	1,135	12.8	16.3	-27%
	Jacket	0.078	0.0020	0.080	ND	ND	12.9	491	12.6	ND	ND
Cargo	Monopile	0.0014	ND	0.0014	0.0013	7%	730	ND	730	759	-4%
	Jacket	0.0014	ND	0.0014	ND	ND	730	ND	730	ND	ND
Tanker	Monopile	0.00083	ND	0.00083	0.00081	2%	1,206	ND	1,206	1238	-3%
	Jacket	0.00083	ND	0.00083	ND	ND	1,206	ND	1,206	ND	ND
Passenger	Monopile	0.00038	ND	0.00038	0.00036	5%	2,648	ND	2,648	2,752	-4%
	Jacket	0.00038	ND	0.00038	ND	ND	2,648	ND	2,648	ND	ND
Military	Monopile	0.000058	ND	0.000058	0.00006	-3%	17,252	ND	17,252	17,829	-3%
	Jacket	0.000058	ND	0.000058	ND	ND	17,252	ND	17,252	ND	ND
Fishing- trawling	Monopile	0.036	0.00010	0.036	0.029	19%	28.0	9,613	27.9	33.9	-22%
	Jacket	0.036	0.00022	0.036	ND	ND	28.0	4,449	27.8	ND	ND
Fishing- transiting	Monopile	0.028	0.00058	0.028	0.024	14%	36.2	1,869	35.6	42.1	-18%
	Jacket	0.028	0.0011	0.029	ND	ND	36.2	897	34.8	ND	ND
Recreation	Monopile	0.0062	0.000099	0.0063	0.0053	16%	162.4	10,100	160	190	-19%
	Jacket	0.0062	0.00021	0.0064	ND	ND	162.4	4,855	157	ND	ND
Tug-Tow	Monopile	0.00011	ND	0.00011	0.00011	0%	9,017	ND	9,017	9415	-4%
	Jacket	0.00011	ND	0.00011	ND	ND	9,017	ND	9,017	ND	ND

Source: COP Appendix III-I, Tables 9.11 and 9.12; Epsilon 2022a

ND = No data
[a:] Accident frequencies are defined as occurrence frequency of vessel grounding, head-on collisions, overtaking collisions, crossing collisions, powered allisions, and drifting allisions. See COP Appendix III-I, Section 9.3.2; Epsilon 2022a.
[b] See Table 3.13-8 for estimated existing collision frequency.
[c] The average number of years between collisions is also referred to as the average recurrence interval.

In response to the potential location of two ESP foundations at a single position within the SWDA (Table 2.1-1 in Chapter 2, Alternatives), the USCG raised the following concerns (Stephen West, Pers. Comm., November 30, 2022):

- Each of the co-located ESPs in one of these pairs could protrude up to 0.07 nautical miles into adjoining of the orthogonal (north-to-south) or east-to-west) or diagonal corridors between WTG and ESP positions in the SWDA. This "double incursion" could reduce the width of horizontal and diagonal corridors below the minimum width recommended in the MARIPARS (USCG 2020), even accounting for micro siting allowances included in those recommendations.
- Co-located ESP foundations could be as close as 500 feet to each other, resulting in ESP platforms that are as close as 172 feet from each other, creating a potential navigation hazard for vessels that travel between these structures.

The USCG also stated that co-located ESPs would need to be properly labeled on navigation charts and would need appropriate lighting, auditory signals (if appropriate), and AIS designation (Stephen West, Pers. Comm., November 30, 2022).

Co-located ESPs would incrementally increase navigational risks and hazards from allision and collision and complicate SAR activities, compared to the impacts discussed above, and would continue to result in **moderate** impacts on navigation and vessel traffic. BOEM is evaluating the following mitigation and monitoring measure to address the impacts of co-located ESPs on navigation and vessel traffic, as described in detail in Table H-2 of Appendix H, Mitigation and Monitoring. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

- Eliminate the option for co-located ESP foundations and require the proposed Project to include no more than one ESP or WTG foundation at each position in the SWDA. This measure would retain the option to mount ESP equipment on WTG platforms.

Decommissioning impacts from the presence of structures would be similar to those for construction, with increased risk of allision, collision, spills, and interruptions in radar imagery. In addition, the presence of partially removed structures would complicate SAR responses due to the removal of previously present structures, beacons, and lights on structures. These impacts would be short term, localized, and **minor**.

The risks associated with decommissioning traffic and vessel activity would be similar to risks associated with construction activity. Phase 1 decommissioning would, therefore, result in short-term, temporary, and **minor** impacts on navigation and vessel traffic during the decommissioning stage.

During decommissioning, Phase 1 would have little to no impact on a mariner's ability to see and use ATONs, although PATONs would be removed from the SWDA (COP Volume III; Epsilon 2022a). Some disruption of established navigation patterns or ATONs in the RI/MA Lease Areas is anticipated due to the presence of decommissioning and removal vessels. Impacts on navigation and vessel traffic during decommissioning would be short term, temporary, and **minor**.

Traffic: Construction of Phase 1 would generate additional domestic and international vessels operating in the SWDA or over the OECC route at any given time (COP Volume III, Section 7.8.2.1.1, and Table 7.8-3; Epsilon 2022a). Up to two vessels trips per day during peak construction would transit to the Phase 1 area from Europe and remain on site from 2 to 12 months. On average, vessels transporting components from Europe directly to the SWDA would make approximately 16 round trips per month over a 2-year offshore construction schedule (COP Volume 1, Section 3.3.1.7; Epsilon 2022a). On average, four cable-laying, support, and crew vessels may be deployed along sections of the OECC during the construction stage, however, as many as approximately seven vessels may be used for cable-laying activities in any 1 month. Since many of the cable installation activities are sequential, these vessels would not all operate along the OECC simultaneously (COP Volume III, Section 3.3.1.12.1; Epsilon 2022a). Vessel traffic associated with Phase 1 construction would not represent a significant increase over the current levels of vessel traffic throughout the RI/MA Lease Areas. The highest density of vessel traffic in the offshore development region occurs outside the RI/MA Lease Areas and primarily within the traffic separation scheme, fairways, precautionary areas, and recommended routes. AIS data suggest that existing vessel traffic levels within the SWDA are relatively low (COP Volume III, Section 7.8.1.1, and Appendix III-I; Epsilon 2022a). Because the SWDA is not heavily trafficked, construction activities would not significantly affect the limited vessel traffic within the SWDA. During Phase 1 construction, the applicant would continue to work with ferry operators, harbor pilots, and other vessel operators to ensure any impacts on commercial vessel traffic are minimized to the greatest extent practicable (COP Volume III, Section 7.8.2.1.5; Epsilon 2022a). The presence of these vessels would increase the risk of allisions, collisions, and spills; however, vessels not associated with the proposed Project would be able to avoid Phase 1 vessels, components, and access restrictions (i.e., safety zones or restrictions established by the USCG around installation vessels) though routine adjustments in 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. During construction, Phase 1 vessel traffic in ports such as ProvPort, Fall River, New Bedford, and Davisville would result in vessel traffic congestion, limited maneuvering space in navigation channels, and delays in ports and could also increase the risk of collision, allision, and resultant spills in or near ports. Vessel traffic generated by Phase 1 construction would constitute less than 10 percent of typical daily vessel transits into and out of the Port of New Bedford (COP Appendix III-I; Epsilon 2022a) but could nonetheless restrict maneuvering room and cause delays accessing the port. This would have localized, long-term, continuous, and **moderate** impacts on navigation and vessel traffic.

SAR activities may be facilitated to some degree due to the presence of several vessels within the SWDA. This would likely include more restricted vessel movement to boaters and low-flying aircraft in the SWDA and an increased likelihood of vessel allision, which may result in more incidents and fewer successful rescues. This would have localized, long-term, continuous, and **minor** impacts on navigation and vessel traffic.

For routine Phase 1 operations, an average of approximately four vessels are anticipated to operate at the SWDA or along the OECC at any given time; additional vessels may be required in other maintenance or repair scenarios. Approximately 250 vessel round trips are estimated to take place annually for Phase 1 operations. As discussed under the port utilization IPF, an average of approximately 6 and up to 15 vessels could operate in the SWDA or along the OECC on any given day during operations, depending on the type of maintenance required, with up to 470 annual vessel round trips (approximately 2 per day) during operations of the proposed Project. Because the SWDA is not heavily trafficked, and because the typical operations vessels would be similar in size and operational requirements to other vessels frequently operating in the RI/MA Lease Areas, Phase 1 operations activities would have few impacts on existing vessel traffic, including passenger vessel traffic. While the level of impact would remain the same, BOEM is evaluating the following mitigation and monitoring measure to address impacts on navigation and vessel traffic, as described in detail in Table H-2 of Appendix H, Mitigation and Monitoring. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

- Reduce overall vessel usage and number of trips within Lease Areas OCS-A 0534 and OCS-A 0501 through a shared operational strategy between Phase 1 and Vineyard Wind 1, which would likely reduce environmental impacts and navigational and vessel traffic risks during operations.

Therefore, Phase 1 operations would have long-term, localized, and **minor** impacts on navigation and vessel traffic.

Increased vessel activity in the SWDA could impact SAR activities by restricting vessel movement and increasing the likelihood of vessel allision and collisions, which may result in more incidents and fewer successful rescues. This would have localized, long-term, continuous, and **minor** impacts on navigation and vessel traffic.

During decommissioning, like construction, the presence support and specialized equipment vessels would increase the risk of allisions, collisions, and spills; however, vessels not associated with the proposed Project would be able to avoid Phase 1 vessels, components, and access restrictions though routine adjustments in 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-removing vessels to pass or idling while work is completed. During decommissioning, Phase 1 vessel traffic in ports such as ProvPort, Fall River, New Bedford, and Davisville would result in vessel traffic congestion, limited maneuvering space in navigation channels, and delays in ports and could also increase the risk of collision, allision, and resultant spills in or near ports. Vessel traffic generated during decommissioning of Phase 1 would constitute less than 10 percent of typical daily vessel transits into and out of the Port of New Bedford (COP Appendix III-I; Epsilon 2022a) but could nonetheless restrict maneuvering room and cause delays accessing the port. This would have localized, long-term, continuous, and **moderate** impacts on navigation and vessel traffic.

Decommissioning impacts on SAR activities and the utilization of aircraft would be similar to those experienced during the construction and operations stages. SAR activities may be facilitated to some degree due to the presence of several vessels within the SWDA. This would likely include more restricted vessel movement to boaters and low-flying aircraft in the SWDA and an increased likelihood of vessel allision, which may result in more incidents and fewer successful rescues. This would have localized, long-term, continuous, and **minor** impacts on navigation and vessel traffic.

Impacts of Phase 2

Phase 2 would affect navigation and vessel traffic through the following primary IPFs during construction, operations, and decommissioning. If the applicant selects the SCV as part of the final proposed Project design, some or all of the impacts on navigation and vessel traffic from the Phase 2 OECC through Muskeget Channel may not occur, while impacts along the SCV route would occur. BOEM will provide a more detailed analysis of the SCV impacts on navigation and vessel traffic in a supplemental NEPA analysis.

Anchoring and gear utilization: The impacts of Phase 2 construction on anchoring would be the same as those for Phase 1. In addition to vessel damage and trip interruption, interruption of Phase 2 construction is also likely in the event of an anchoring incident, although this would be most likely only in areas of hard cover and scour protection over foundations and cables. These impacts would be localized, temporary to short term, and **minor**.

The impacts of Phase 2 construction on anchoring and gear utilization for the SCV would be similar to those impacts described for Phase 1, in additional locations (i.e., along the SCV route). These impacts would be localized, temporary to short term, and **minor**.

Smaller vessels anchoring in the SWDA may have issues with anchors failing to hold near foundations and any associated scour protection, or, alternately, where the anchors may become snagged and potentially lost. Potential impacts from anchoring include deep draft vessels anchoring in an emergency scenario, resulting in damage to the export cable, risks associated with an anchor contacting an electrified cable, and impacts on the vessel operator’s liability and insurance.

Impacts of anchoring and gear utilization during Phase 2 (including the SCV) would be the same as those for Phase 1. In addition to vessel damage and trip interruption, interruption of Phase 2 construction is also likely in the event of an anchoring incident, although this would be most likely only in areas of hard cover and scour protection over foundations and cables. The operational impacts on anchoring and gear utilization would be localized, long term, and **negligible.** The decommissioning and removal of export cables from the SWDA and the OECC for Phase 2 would have the same impacts on anchoring and gear utilization as construction for both phases and decommissioning of Phase 1. These impacts would be localized, temporary to short term, and **negligible**.

Cable emplacement and maintenance: Phase 2 impacts for cable emplacement would be similar to those identified for Phase 1. Cable emplacement during Phase 2 could include two routes. The applicant's preferred route for the Phase 2 OECC would parallel the Phase 1 OECC. If necessary, due to technical, logistical, grid interconnection, or other unforeseen issues, the Phase 2 OECC could use the Western Muskeget Variant and/or the SCV. Cable installation along the OECC and within the SWDA could also lead to increased congestion and navigational complexity, which could result in crew fatigue, damage to vessels and fishing gear, injury to crews, engagement of USCG SAR, and vessel fuel spills. Vessels not involved in cable emplacement or maintenance would need to take additional care when crossing cable routes or avoid installation or maintenance areas entirely during installation and maintenance activities. Areas disturbed by OECC construction for Phase 2 would produce localized, temporary changes in fishing, fishing transit, and other commercial or recreational navigation routes or events due to cable emplacement and maintenance, which would constitute a **minor** impact.

An analysis of 2016 to 2019 AIS data for the federal waters portion of the SCV evaluated the location and frequency of vessel crossings. This analysis showed that vessel traffic density along the SCV is relatively low overall, with the highest traffic concentration closer to shore. Approximately 69 AIS-equipped vessels crossed the SCV daily, most of which were fishing, recreational, or tug-towing (Epsilon 2022a). SCV construction would generate localized, temporary changes in fishing, fishing transit, and other commercial or recreational navigation routes or events due to cable emplacement and maintenance, which would constitute a **minor** impact.

Impacts of cable emplacement and maintenance for Phase 2 operations (including operations related to the SCV) would be the same as those for Phase 1. Phase 2 would include more restricted vessel movement in the SWDA and OECC during cable maintenance activities. This would lead to increased congestion and navigational complexity within the SWDA, 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 SWDA. This would have localized, short-term, intermittent, and **negligible** impacts on navigation and vessel traffic. The decommissioning and removal of export cables from the SWDA and the OECC for Phase 2 would have the same impacts on cable emplacement and maintenance as construction for both phases and decommissioning of Phase 1. These impacts on navigation and vessel traffic would be localized, short term, intermittent, and **negligible**.

Port utilization: The impacts of Phase 2 construction on port utilization (with or without the SCV) would be similar to those of Phase 1 and could include increased port traffic and space use conflicts. The magnitude of these impacts would vary across ports and depend on the specific Phase 2 construction use of each port. As a result, construction of Phase 2 would have short-term, continuous, and **moderate** impacts on navigation and vessel traffic.

Impacts on port utilization during Phase 2 operations (including operations related to the SCV) would be similar to those of Phase 1. The proposed Project would likely share some vessels between Phases 1 and 2, thus consolidating trips while both phases are operating. Approximately 470 vessel round trips are estimated to take place annually during the simultaneous operations of both phases, which equates to an average of less than 2 vessel round trips per day. This number would reduce if trips were consolidated. Because an average of fewer than two operations vessels would transit to and/or from the operations facility on any given day, vessel activities at the operations facility are not expected to affect other commercial or recreational vessel traffic (COP Volume III, Section 7.8.2.2.1; Epsilon 2022a). Therefore, Phase 2 operations would have localized, long-term, continuous, and **minor** impacts on port utilization and availability.

The decommissioning and removal of structures and export cables from the SWDA and the OECC (including the SCV OECC) for Phase 2 would have the same impacts on port utilization as decommissioning of Phase 1. Impacts on port utilization during decommissioning would be short term, continuous, and **moderate**.

Presence of structures: Phase 2 would add up 82 new stationary structures to the SWDA during construction. This would contribute 218 acres of impact for foundation and scour protection installation and 29 acres of impact for hard protection for offshore and inter-array cables (COP Appendix III-T, Table 1; Epsilon 2022a). The SCV could require up to 42 acres of hard protection (Epsilon 2022a). Impacts from the presence of structures during Phase 2 would be the same as for Phase 1: short term, continuous, and **moderate**.

Phase 2 would add up to a total maximum of 82 new stationary structures to the SWDA during operations, where there was previously open unobstructed ocean. Impacts of Phase 2 operations from the presence of these structures would be similar to those for Phase 1, reflecting increased risk of allision/collision (Table 3.13-7), delayed or degraded SAR response, and space use conflicts. This would result in long-term, continuous, and **moderate** impacts on navigation and vessel traffic.

The decommissioning and removal of structures and of export cables from the SWDA and the OECC for Phase 2 (including the SCV OECC) would have the same impacts of the presence of structures as construction for both phases and decommissioning of Phase 1, including the removal of all obstructions and PATONS. Impacts from the presence of structures at decommissioning, like construction, would be short term, localized, and **moderate**.

Traffic: Impacts on vessel traffic during construction of Phase 2 (including the SCV) would be the same as for Phase 1. Construction of Phase 2 would generate additional domestic and international vessels operating in the SWDA or over the OECC route at any given time (COP Volume III, Section 7.8.2.1.1, and Table 7.8-3; Epsilon 2022a). Selection of the SCV as part of the proposed Project would have similar impacts along the SCV OECC route. The presence of these vessels would increase the risk of allisions, collisions, and spills; however, vessels not associated with the proposed Project would be able to avoid Phase 2 vessels, components, and access restrictions though routine adjustments in 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. During construction, Phase 2 vessel traffic in ports such as ProvPort, Fall River, New Bedford, and Davisville would result in vessel traffic congestion, limited maneuvering space in navigation channels, and delays in ports and could also increase the risk of collision, allision, and resultant spills in or near ports. Construction of Phase 2 would have localized, long-term, continuous, and **moderate** impacts on navigation and vessel traffic.

SAR activities may be facilitated to some degree due to the presence of vessels, WTGs and ESPs could provide refuge for incident victims, and marking of individual WTGs could facilitate location and rescue by the USCG. This would likely include more restricted vessel movement to boaters and low-flying aircraft in the SWDA and an increased likelihood of vessel allusion, which may result in more incidents and fewer successful rescues. This would have localized, long-term, continuous, and **minor** impacts on navigation and vessel traffic.

Impacts on traffic as result of Phase 2 operations (including operations associated with the SCV) would be the same as those under Phase 1. The proposed Project would likely share some vessels between Phases 1 and 2 while both phases are operating. A shared operational strategy would enhance operational efficiencies and likely minimize impacts during operations by reducing overall vessel usage within the SWDA. For routine operations of the proposed Project, it is anticipated that an average of approximately six vessels would operate at the SWDA or along the OECC on any given day. In other maintenance or repair scenarios, additional vessels may be required, which are estimated to result in a maximum of approximately 15 vessels operating within the SWDA or along the OECC at one time. These increases in vessel traffic from Phase 2 operations would be minimal compared to existing vessel traffic, including passenger vessel traffic. While the level of impact would remain the same, BOEM is evaluating the following mitigation and monitoring measure to address impacts on navigation and vessel traffic, as described in detail in Table H-2 of Appendix H. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval:

- Reduce overall vessel usage and number of trips within Lease Areas OCS-A 0534 and OCS-A 0501 through a shared operational strategy between Phase 2 and Vineyard Wind 1, which would likely reduce environmental impacts and navigational and vessel traffic risks during operations.

Therefore, operations of Phase 2 would have long-term, localized, and **minor** impacts on navigation and vessel traffic.

The decommissioning and removal of structures and of export cables from the SWDA and the OECC for Phase 2 would have the same impacts on traffic as construction for both phases and decommissioning of Phase 1. This would have localized, long-term, continuous, and **moderate** impacts on navigation and vessel traffic.

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-10 in Appendix G would contribute to impacts on navigation and vessel traffic through the primary IPFs of presence of structures, which increases the risk of collision/allision and navigational complexity. The cumulative impacts on navigation and vessel traffic would range from **negligible** to **moderate**.

Conclusions

Impacts of Alternative B. Construction, operations, and decommissioning of Alternative B would have **negligible** to **moderate** impacts on navigation and vessel traffic. Impacts on vessels not associated with Alternative B would include changes in navigation routes, delays in ports, degraded communication and radar signals, and increased difficulty of offshore SAR or surveillance missions within the SWDA, all of which would increase navigational safety risks. Some commercial fishing, recreational, and other vessels would choose to avoid the SWDA altogether, leading to some potential funneling of vessel traffic along the SWDA borders. Generally, fewer turbines (i.e., implementation of the larger 16 or 19 MW turbines) in the SWDA would reduce potential impacts on navigation and vessel traffic.

The impact analysis is based on a maximum-case scenario, and if the applicant would implement a less impactful scenario within the PDE, smaller amounts of construction or infrastructure development would result in lower impacts but would not likely result in different impact ratings than those described above.

Cumulative Impacts of Alternative B. The cumulative impacts on navigation and vessel traffic in the geographic analysis area would be **negligible** to **moderate**. The main IPF is the presence of structures, which increases the risk of collision/allision and navigational complexity. Considering all the IPFs together, the overall impacts on navigation and vessel traffic from ongoing and planned activities, including Alternative B, would be **moderate**, due primarily to the increased possibility for loss of life due to maritime incidents, which would produce significant local and possibly regional disruption for ocean users in the RI/MA Lease Areas.

3.13.2.4 Impacts of Alternative C – Habitat Impact Minimization Alternative on Navigation and Vessel Traffic

Alternatives C-1 and C-2 would not affect the number or placement of WTGs or ESPs for the proposed Project compared to Alternative B. Alternatives C-1 and C-2 would alter the exact routes of inter-array, inter-link, and export cables installed for the proposed Project, and could, thus, affect the exact length of cable installed and area of ocean floor disturbed or the exact location of construction or maintenance vessel activity. These differences would not result in meaningfully different impacts compared to Alternative B. Therefore, the impacts of Alternatives C-1 and C-2 on navigation and vessel traffic would be the same as those for Alternative B.

3.14 Other Uses (National Security and Military Use, Aviation and Air Traffic, Offshore Cables and Pipelines, Radar Systems, Scientific Research and Surveys, and Marine Minerals)

3.14.1 Description of the Affected Environment

3.14.1.1 Geographic Analysis Area

This section discusses existing conditions in the geographic analysis area for uses of the OCS not addressed in other portions of the Draft EIS—national security and military use, aviation and air traffic, offshore cables and pipelines, radar systems, scientific research and surveys, and marine minerals—hereafter "other uses," as described in Table D-1 in Appendix D, Geographical Analysis Areas, and shown on Figure 3.14-1. The geographic analysis area for other uses includes Nantucket Sound, areas south of Martha's Vineyard and Nantucket, the RI/MA Lease Areas, and waters surrounding potential vessel routes to the ports identified for use by the applicant, as well as the cities and towns surrounding the areas where proposed Project-related activities would occur. The geographic analysis area for scientific research and surveys is the same as the geographic analysis area for finfish, invertebrates, and EFH (Section 3.6) and includes U.S. waters from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina.

3.14.1.2 Existing National Security and Military Uses

Branches of the military currently use and will continue to use the airspace and waters in this area for operations and training. The U.S. Navy, the USCG, and other military and national security entities have numerous facilities in the region (Figure 3.14-2). Major onshore regional military and national security facilities include Naval Station Newport, Naval Submarine Base New London, the Northeast Range Complex/Narragansett Bay Operation Area, Joint Base Cape Cod, and numerous USCG stations (COP Volume III, Section 7.9.1; Epsilon 2022a). 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 (including SAR)[30], as well as non-routine activities. Military air traffic uses the area, and other government (or government-hired private) aircraft may occasionally fly over the SWDA for data collection and SAR operations.

The SWDA is not located within territorial airspace (i.e., up to 12 nautical miles [14 miles] from shore). However, portions of the OECC, portions of the vessel routes between port facilities and the SWDA, and the port facilities themselves are within territorial airspace. The U.S. Navy and other Department of Defense (DoD) branches use the airspace over and adjacent to the SWDA. The SWDA, along with much of the RI/MA Lease Areas, is within Warning Area W-105A, a block of airspace ranging from 0 to 50,000 feet above mean sea level (AMSL), part of the U.S. Navy-managed Narragansett Bay Complex (COP Volume III, Appendix J; Epsilon 2022a; GlobalSecurity.org 2018). Warning Area W-105A is primarily used by the U.S. Air Force (USAF), specifically the 104th Fighter Wing, a unit of the Massachusetts Air National Guard, for operations above 1,000 feet AMSL, but may also be used by other military entities.

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[30] While SAR occurs on an as-needed basis and, thus, could be considered non-routine, USCG and other entities conduct regular SAR training and perform active SAR missions frequently enough in or near the geographic analysis area that SAR is evaluated here as a routine activity.

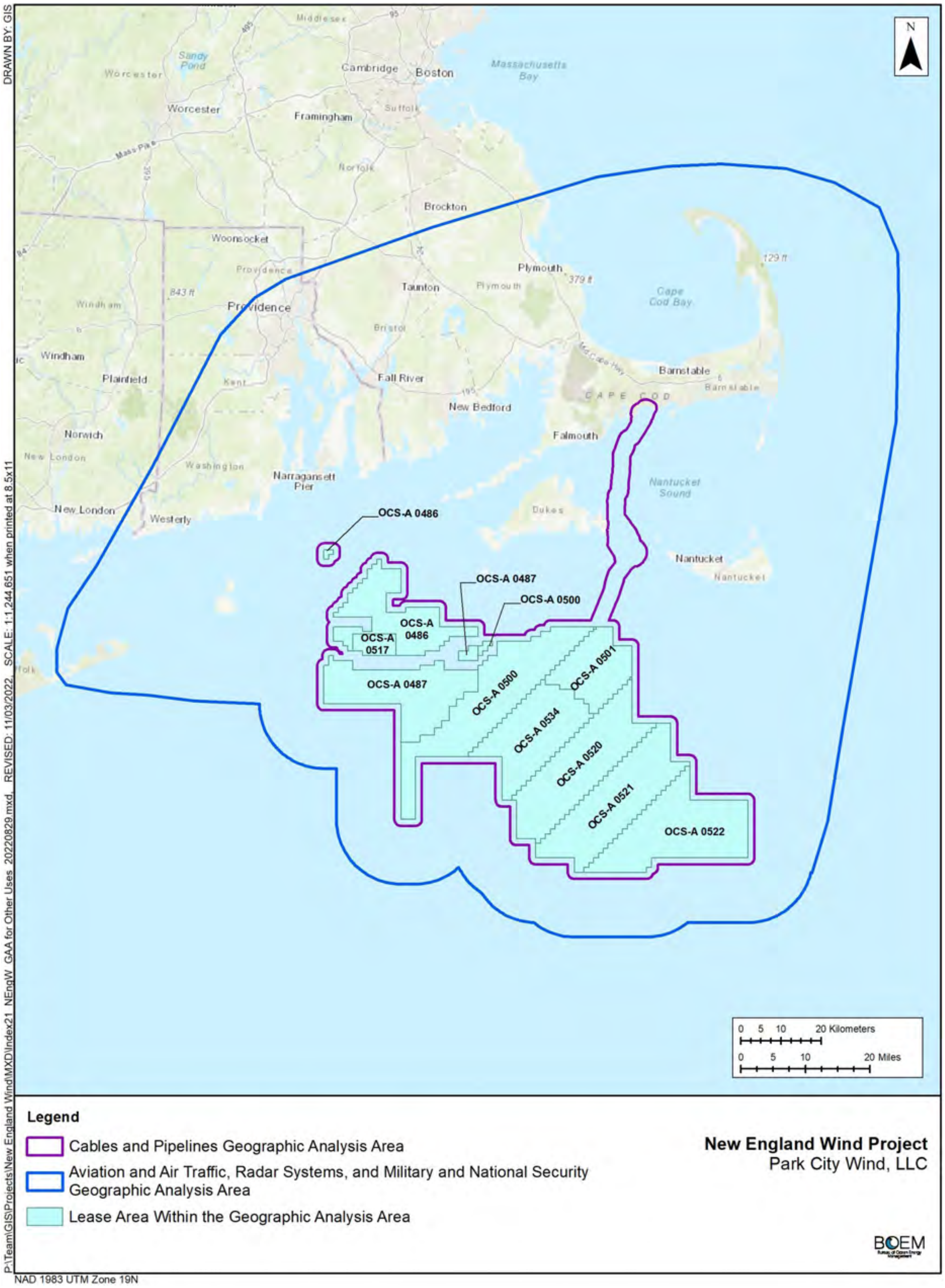
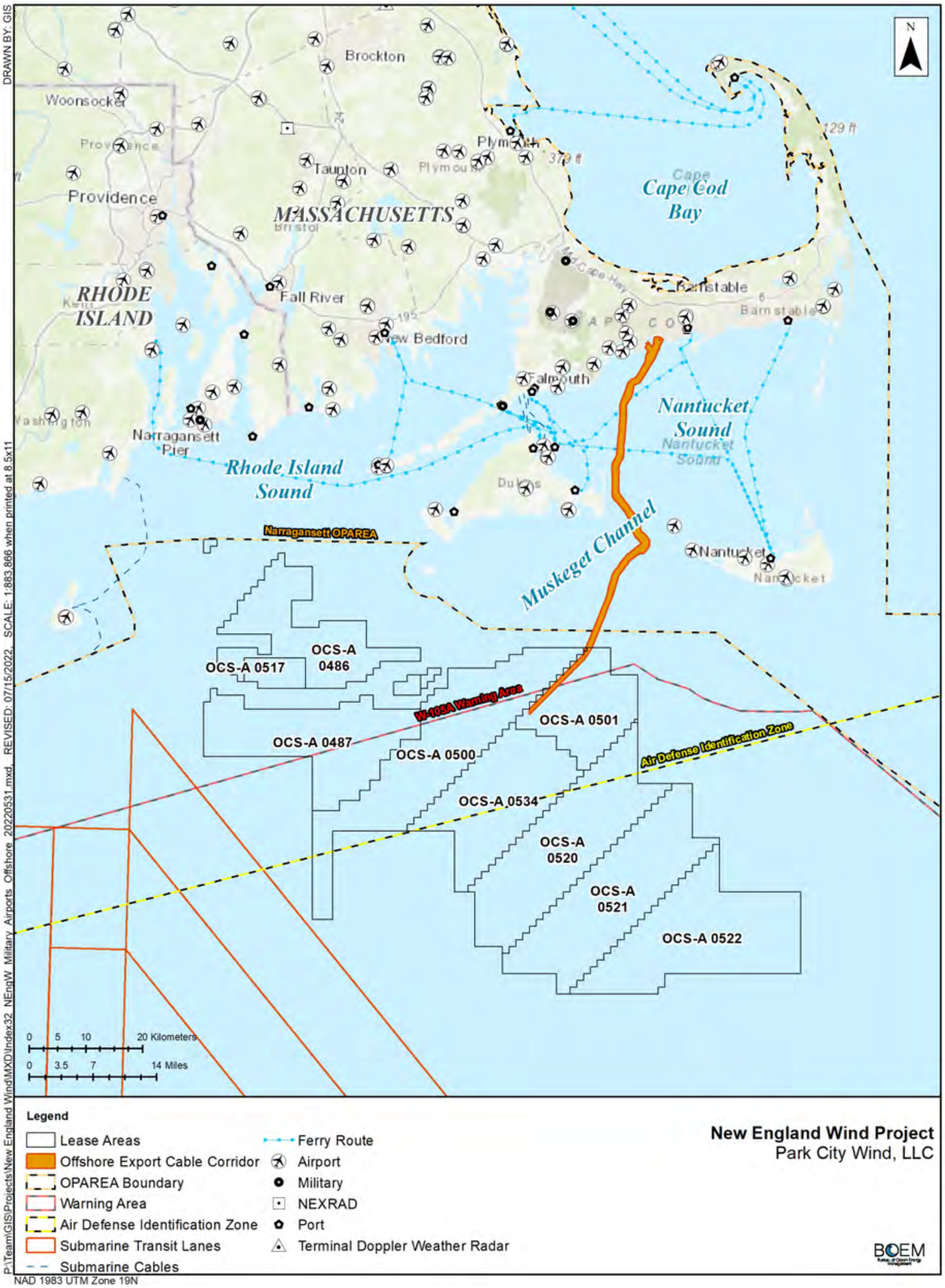


Figure 3.14-1: Geographic Analysis Area for Other Uses



NEXRAD = Next Generation Weather Radar; OPAREA = operating area

Figure 3.14-2: Military and National Security Facilities

USAF activities within W-105A include, but are not limited to, supersonic operations (above 10,000 feet AMSL) and release of flares and chaff down to 2,000 feet (BOEM 2021b). A portion of the SWDA is located within the limits of the Air Defense Identification Zone. All international flights entering this zone must provide the appropriate documentation, but the SWDA's presence in this zone is not likely to have a physical impact on aviation operations. National defense radar systems operating within the region include the Precision Acquisition Vehicle Entry/Phased Array Warning System installation at Joint Base Cape Cod and other military radars (COP Volume III, Section 7.9; Epsilon 2022a). Military training exercises typically occur in deeper offshore waters southeast of the SWDA, although military vessels transit through the SWDA (COP Volume III, Section 7.8, Epsilon 2022a).

3.14.1.3 Existing Aviation and Air Traffic

There are numerous public and private-use airports in the region. Major airports in the region include Boston Logan International Airport approximately 90 miles north of the SWDA, and T.F. Green Airport in Providence, Rhode Island, approximately 65 miles northwest of the SWDA. The closest public airports to the SWDA are Nantucket Memorial Airport on Nantucket and Katama Airfield and Martha's Vineyard Airport, both located on Martha's Vineyard. Private airports or airstrips near the SWDA are located on Tuckernuck Island and Martha's Vineyard (Trade Wind Airport). Other public and private airports and heliports are located on the mainland.

General aviation traffic in and near the SWDA is highest during the summer tourism season. Over a 1-year period between April 2020 and April 2021, Martha's Vineyard Airport hosted 32,588 aircraft operations, while Nantucket Memorial Airport hosted 52,542 operations (FAA 2022). Commercial and long-distance flights typically occur at or above 18,000 feet AMSL. High-performance jet and turboprop aircraft generally follow instrument flight rules (IFR) routes between 3,000 and 7,000 feet AMSL. Other aircraft operate using VFR, which do not require designated routes or altitudes. VFR pilots are required to maintain a minimum 500 feet AMSL clearance from any structure or vessel (14 CFR § 91.119). There are no minimum altitude restrictions over water in the absence of any structures or vessels (BOEM 2014b). The Aviation Impact Assessment for Vineyard Wind 1 found that more than 90 percent of existing air traffic over the wind development area for that project (just northeast of the SWDA) occurred at altitudes that would not be impacted by the WTG placements (Epsilon 2020). The FAA has authority to review proposed structures greater than 200 feet AMSL and within 12 nautical miles (13.8 miles) of the shoreline to determine whether the activity would impact safe and efficient use of navigable airspace or air navigation and communication facilities. Construction cranes, construction of turbines in port, and transport of constructed turbines to the leased areas could also necessitate FAA aeronautical studies and compliance with FAA requirements and guidelines for marking and lighting.

3.14.1.4 Existing Offshore Cables and Pipelines

The coastal region of Massachusetts is served by an onshore electrical grid and a network of onshore pipelines. Islands in the region, including Martha's Vineyard and Nantucket, are served by submarine electrical transmission cables. Currently, a total of five submarine transmission cable systems are located in Nantucket Sound, which are identified on NOAA navigational charts for Nantucket and Martha's Vineyard (Figure 3.14-3). Three of the five cables service Martha's Vineyard by connecting the Town of Falmouth on Cape Cod with Vineyard Haven and Tisbury through eastern Vineyard Sound. The two remaining cables service Nantucket with cables from Dennis Port and Hyannis Port (departing from Kalmus Beach in Outer Lewis Bay) interconnecting through Nantucket Sound to a landfall at Jetties Beach.

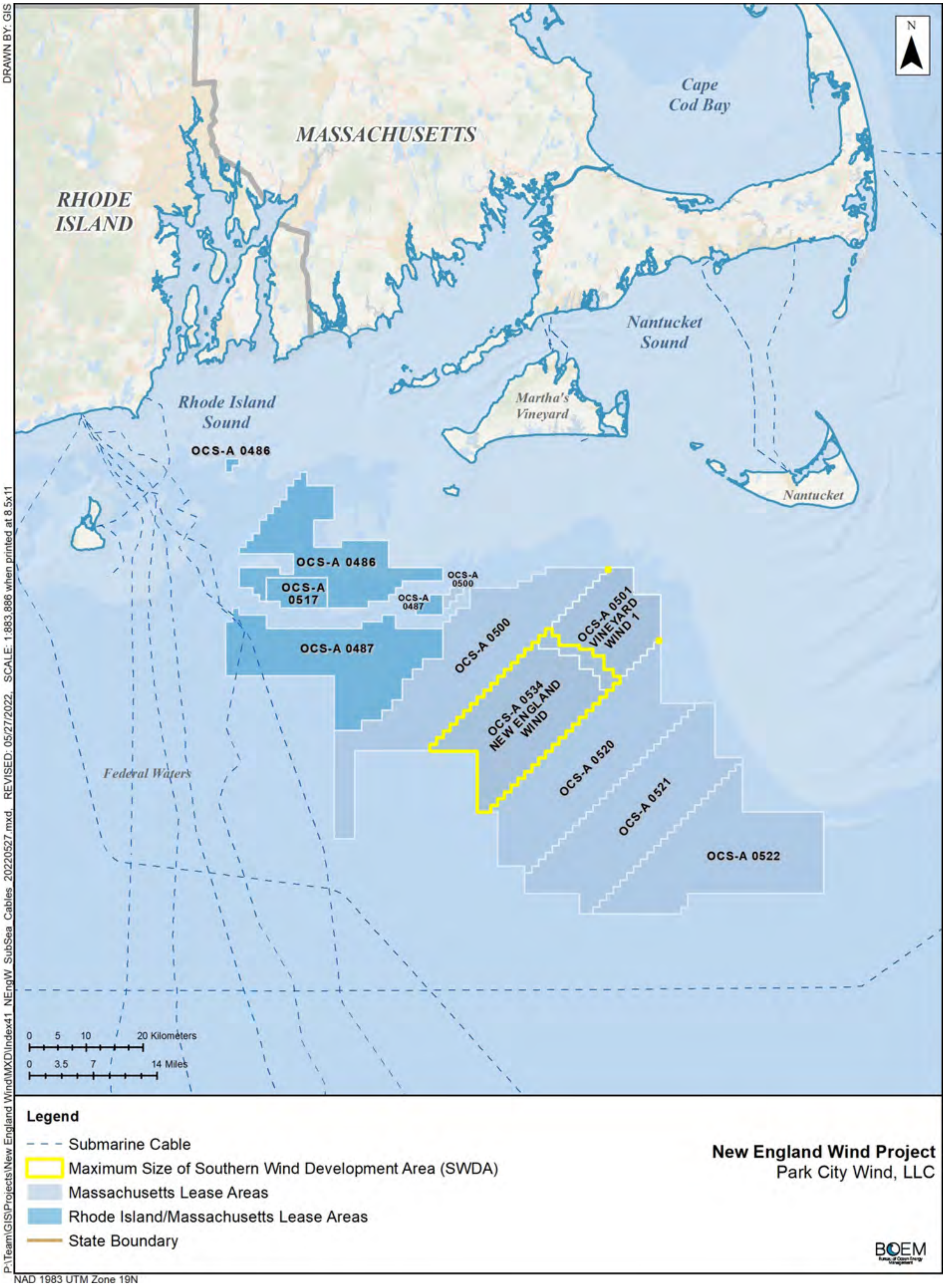


Figure 3.14-3: Submarine Transmission Cables

No offshore pipelines are located within or in the region immediately surrounding the SWDA. Two cables are within the geographic analysis area and cross the far western side of Lease Area OCS-A 0487, approximately 20 miles west-to-northwest of the SWDA. The proposed Project would not intersect and is not expected to impact or be impacted by these submarine transmission cable systems; therefore, the transmission cables in Lease Area OCS-A 0487 are not discussed further.

3.14.1.5 Existing Radar Systems

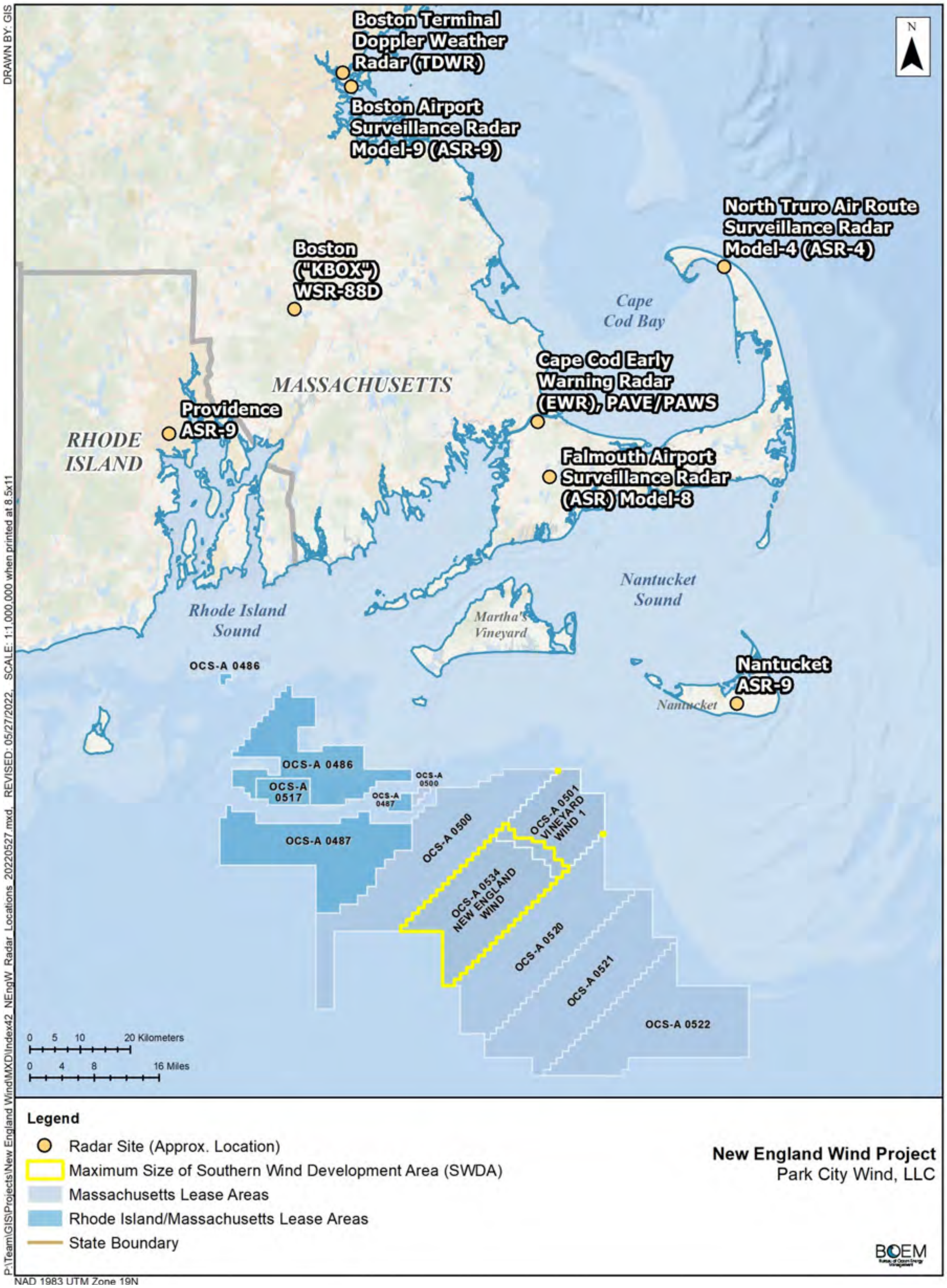
Radar systems for marine navigation are discussed in Section 3.13, Navigation and Vessel Traffic. Commercial air traffic control radar systems, national defense radar systems, and weather radar systems currently operate in the region to serve national defense, weather, and air traffic control purposes. The closest FAA Terminal Doppler Weather Radar (TDWR) facilities are located near Boston Logan International Airport (Boston TDWR), more than 90 miles from the SWDA. Next Generation Weather Radar (NEXRAD) is a network of 160 high-resolution Doppler weather radars, operated by the National Weather Service (NWS), used for weather forecasting purposes. NEXRAD installations around the SWDA include the NWS Taunton, Massachusetts facility (KBOX), and the NWS Brookhaven, New York facility (KOKX).

Rutgers University maintains a series of high -frequency radars that study ocean currents as part of the Mid Atlantic High Frequency Radar Network, including installations on Nantucket, Martha’s Vineyard, and Block Island (Roarty 2020). Military radar systems within the geographic analysis area include the Precision Acquisition Vehicle Entry/Phased Array Warning System installation at Joint Base Cape Cod (also known as Cape Cod Air Force Station Early Warning Radar [AFS EWR]). Other radar sites within the geographic analysis area include Boston Airport Surveillance Radar (ASR)-9, Cape Cod Air Force Station Early Warning Radar, Falmouth ASR-8, Nantucket ASR-9, North Truro Air Route Surveillance Radar (ARSR)-4, Coventry (Providence) ASR-9, Riverhead ARSR-4, Boston (KBOX) Weather Surveillance Radar (WSR)-88D, and Brookhaven WSR-88D (COP Volume III, Section 7.9.1.6; Epsilon 2022a). The DoD uses the Cape Cod AFS EWR for ballistic missile defense and space surveillance. The North American Aerospace Defense Command’s (NORAD) radar operations and defense of national critical infrastructure are located in the same geographic areas (BOEM 2021b). Existing radar systems would continue to provide weather, navigational, and national security support to the region.

Ten primary surveillance radar sites are within approximately 100 nautical miles (115 miles) of the SWDA (Figure 3.14-4). These radar sites provide radar data to multiple DoD, Department of Homeland Security (DHS), FAA, and NOAA facilities for conducting air traffic control, air defense, ballistic missile defense, homeland security, space surveillance, and weather operations. Two navigational aid sites are near the proposed wind turbines, Martha’s Vineyard VHF omnidirectional range and co-located distance measuring equipment. Additionally, 12 coastal high frequency radar sites were identified in the vicinity of the SWDA, as well as two navigational aid sites in Martha’s Vineyard and Nantucket.

3.14.1.6 Existing Scientific Research and Surveys

Research in the geographic analysis area includes oceanographic, biological, geophysical, and archaeological surveys focused on the OCS and nearshore environments, and/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/MA Lease Areas and surrounding waters. Aerial and ship-based research include 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.



PAVE/PAWS = precision avionics vectoring equipment/phased array warning system

Figure 3.14-4: Surveillance Radar Sites

The NEFSC, NMFS, NOAA, and MA DMF operate or support surveys related to ecological monitoring and fisheries stock assessments in the RI/MA Lease Areas and surrounding region. These surveys are used in part to develop data that inform stock assessments and fisheries management and influence fisheries management planning. Fisheries stock assessment surveys and ecological monitoring surveys that occur in the region include, but are not limited to:

- NEFSC northeast bottom trawl survey;
- NEFSC surf clam/ocean quahog survey;
- MA DMF spring and fall trawl surveys;
- New England Aquarium aerial surveys;
- Virginia Institute of Marine Science scallop dredge survey;
- Atlantic Marine Assessment Program for Protected Species surveys; and
- Surveys conducted by the applicant and other offshore wind leaseholders, which would only occur in their respective lease areas.

Specific biological surveys conducted in leased areas offshore Massachusetts include vessel-based surveys to monitor marine mammals, sea turtles, and seabirds, and NARW aerial surveys. Other activities anticipated to continue or occur within the geographic analysis area include offshore wind site assessment activities, construction of planned 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.

3.14.1.7 Existing Marine Minerals

The demand for sand resources suitable for beach replenishment efforts along the Atlantic Coast has increased due to shoreline erosion, damage from coastal storms, and climate change-induced sea level rise. BOEM funded offshore surveys from 2015 to 2017 as part of the Atlantic Sand Assessment Project to identify sources of sand in federal waters to help coastal communities recover from storms and coastal erosion (BOEM Undated). BOEM’s Marine Minerals Information System indicates no sand resource areas or federal OCS sand and mineral lease areas located within the geographic analysis area (BOEM-MMIS Undated). Additionally, no significant sand resource blocks were identified in the geographic analysis area (COP Volume III, Section 7.9; Epsilon 2022a).

3.14.2 Environmental Consequences

Definitions of impact levels for other uses are described in Table 3.14-1. There are no beneficial impacts on other uses.

Table 3.14-1: Impact Level Definitions for Other Uses

Impact Level	Definition
Negligible	Impacts would be so small as to be unmeasurable.
Minor	Impacts on the affected activity would be avoided, and impacts would not disrupt the normal or routine functions of the affected activity. Once the proposed Project is decommissioned, the affected activity would return to a condition with no measurable impacts.
Moderate	Impacts on the affected activity would be unavoidable. The affected activity would have to adjust to account for disruptions due to impacts of the proposed Project, or once the proposed Project is decommissioned, the affected activity could return to a condition with no measurable impacts if proper remedial action is taken.
Major	The affected activity would experience unavoidable disruptions to a degree beyond what is normally acceptable, and once the proposed Project is decommissioned, the affected activity could retain measurable impacts indefinitely, even if remedial action is taken.

3.14.2.1 Impacts of Alternative A – No Action Alternative on Other Uses

When analyzing the impacts of Alternative A on other uses, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on existing conditions for other uses (Table G.1-11 in Appendix G, Impact-Producing Factor Tables and Assessment of Resources with Minor [or Lower] Impacts). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for other uses described in Section 3.14.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on other uses would continue to follow current regional trends and respond to current and future environmental and societal activities. While the proposed Project would not be built under Alternative A, ongoing activities, future non-offshore wind activities, and future offshore wind activities would have continuing short- and long-term impacts on other uses. This section discusses the environmental consequences of Alternative A on other uses.

National security and military uses: National security and military interests would continue to use the onshore and offshore areas in the geographic analysis area. Ongoing activities could potentially affect military and national security activities if facilities or associated vessel traffic limits maneuverability of military aircraft or vessels or affects the scope of military or national security operations. Existing stationary facilities that present allision risks act as fish aggregating devices (FAD) or pose navigational hazards 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 offshore portion of the geographic analysis area, but private or commercial docks may be added close to the shoreline. Onshore facilities that may pose navigational hazards include onshore wind turbines, communication towers, and other onshore commercial, industrial, and residential structures.

No future non-offshore wind stationary structures that could affect national security and military activity 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. Current and future vessel traffic in the region is described in Section 3.13. Current activities associated with offshore wind in the geographic analysis area are limited to vessels conducting site assessment surveys.

Aviation and air traffic: Air traffic is expected to continue at current levels in and around the SWDA. Ongoing activities could potentially affect aviation and air traffic by introducing obstructions to airspace and altering navigational routes. Existing aboveground stationary facilities within the geographic analysis area that present navigational hazards or may potentially cause space use conflicts 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 AMSL. 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.

Offshore cables and pipelines: Five existing submarine cables extend between the mainland and Nantucket and Martha’s Vineyard. These submarine cables would remain in current locations with infrequent maintenance continuing along those cable routes for the foreseeable future. Ongoing activities could potentially affect existing cables by damaging or causing service outages to existing offshore power cables, or by affecting the siting of future cables. Structures within and near the geographic analysis area that pose potential allision hazards to cable maintenance vessels 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 structures.

Radar systems: Ongoing activities could potentially affect radar systems if construction or operational activities cause interference with radar signals. WTGs in the direct line-of-sight with or extremely close to radar systems can cause clutter and interference, which can result in false targets, reduced radar sensitivity, decreased probability of detection, and radar tracking anomalies. Existing wind energy developments in the area include scattered onshore wind turbines and five WTGs in the Block Island Wind Farm. Planned non-offshore wind structures proposed for construction in the lease areas that could affect radar systems have not been identified.

Scientific research and surveys: Scientific research activities would continue into the foreseeable future, although at potentially different levels in the geographic analysis area due to ongoing research and new opportunities. Ongoing activities (including climate change) could potentially affect scientific research and surveys by increasing or decreasing opportunities for research or through navigation obstructions that impede research, which in turn may affect survey methodologies and data collection practices, and may increase scientific uncertainty in fish stock assessments, endangered species monitoring, and other research efforts. Stationary structures are limited in the open ocean environment of the geographic analysis area, and include meteorological buoys associated with site assessment activities, the five Block Island Wind Farm WTGs, and the two Coastal Virginia Offshore Wind Project WTGs offshore Virginia. Although not yet constructed, Vineyard Wind 1 and the South Fork Wind Projects, both within the geographic analysis area, have been approved by BOEM and are expected to be constructed and operational in the near future. Other lease areas within the geographic analysis area are not yet developed and are in various stages of permitting.

Marine minerals: Ongoing activities are unlikely to impact marine minerals because there are no sand resource areas or federal OCS sand and mineral lease areas or significant sand resource blocks located within the geographic analysis area (BOEM-MMIS Undated).

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on other uses include continued operations of the Block Island Wind Farm and ongoing construction of Vineyard Wind 1 in OCS-A 0501 and the South Fork Wind Project in OCS-A 0517. Ongoing operations of the Block Island Wind Farm and ongoing construction of the Vineyard Wind 1 and South Fork Wind Projects, along with planned offshore wind activities, would affect other uses through the primary IPFs described below.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than Alternative B). Future offshore wind development activities would affect other uses through the following primary IPFs.

National Security and Military Uses

The boundaries of the RI/MA Lease Areas 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.

Cable emplacement and maintenance: Ongoing activities and future non-offshore wind activities are limited to infrequent maintenance events along existing submarine cables within the geographic analysis area. Construction from future offshore wind activities would cause military and national security vessels to change route or navigate around temporarily active construction sites above cables. Military and national security vessels would also need to avoid anchoring in any hard protection areas. Construction from future offshore wind activities would occur between 2022 and 2030, with up to seven offshore wind projects under construction simultaneously in 2025. BOEM assumes all offshore wind project developers would coordinate with the DoD and the U.S. Navy on any proposed uses of distributed acoustic sensing (DAS) to address impacts on U.S. Navy operations, as required by conditions in the COPs for those projects.

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 913 WTGs and 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/MA Lease Areas starting in 2022 through 2030, with up to six offshore wind projects under construction simultaneously in 2025 (Table E-1 in Appendix E). 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 agreement among all RI/MA Lease Areas applicants to locate WTGs and ESPs in a 1-nautical-mile (1.9-kilometer, 1.15-mile) × 1-nautical-mile (1.9-kilometer, 1.15-mile) grid, pursuant to USCG's MARIPARS (USCG 2020). This arrangement is intended to facilitate safe navigation through the RI/MA Lease Areas (Brostrom et al. 2019). The Final MARIPARS did not recommend implementation of any formal routing measures (USCG 2020).

The installation of up to 1,043 foundations within the geographic analysis area could create an artificial reef effect, attracting species of interest for recreational fishing or sightseeing, resulting in vessels that may travel farther offshore than typically occurs. Recreational fishing vessel traffic would be additive to vessel traffic that already transits the leased areas and could increase demand for USCG SAR operations near the WTGs. 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 of navigation channels unless necessary for SAR operations or non-typical activities. Risk would gradually increase between 2023 and 2030 as offshore wind structures are installed across the RI/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 1,043 foundations within the geographic analysis area between 2023 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 2023 and 2030, use of stationary lift vessels in the lease areas, cranes at port locations, and vessels transporting WTGs components in transit between the two 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. It is assumed that other offshore wind operators would implement a strict operational protocol with the USCG that requires operators to maintain control over the WTGs to selectively stop rotation and orient blades and nacelles within a specified time to mitigate impacts on SAR aircraft operating in the leased areas. Additionally, USCG would need to adjust their SAR planning and search patterns to allow aircraft to fly within the geographic analysis area, leading to a less optimized search pattern and a lower probability of success. Prior to construction, applicants must file Form 7460-1 (Notice of Proposed Construction) with the FAA for each individual structure exceeding 200 feet AMSL within U.S. territorial waters, which triggers a review to identify and resolve potential aviation conflicts. The DoD and the DHS, (which typically includes the USCG) 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 2019a), and BOEM assumes that this process would be used, in addition to any pre-permitting coordination performed by the proposed Project applicants, to identify and resolve potential conflicts with military air traffic. For example, the Bay State Wind Project, which is proposed to be located in OCS-A 0500 and overlaps W-105A, received Determinations of No Hazard for WTG blade tips up to 1,049 feet AMSL (FAA 2019b). Implementation of navigational lighting and marking per FAA (2020), USCG (2019), and BOEM (2021a) requirements and guidelines 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/MA Lease Areas between 2023 and 2030. Presence of the proposed 1,043 foundations during the various project operational timeframes would change long-term navigation patterns in and around the RI/MA Lease Areas. As multiple projects are built, changing navigation patterns could concentrate vessels around the edges of the leased areas, potentially causing space use conflicts and increasing the risk of collisions between military/national security and civilian vessels. Warning area W-105A overlies the SWDA (COP Volume III, Appendix J; Epsilon 2022a). Wind development in the lease areas could have an increasing impact on the USAF 104th Fighter Wing's ability to train within W-105A as construction occurs in these areas between 2023 and 2030, and a consistent impact during project operations.

All the offshore wind projects in the RI/MA Lease Areas would construct OECCs within the geographic analysis area for other uses, generally from the northern portion of each lease area to a landing site in Massachusetts, Rhode Island, or another state. Precise cable corridors are not known for any specific project, but construction timeframes would likely be staggered between 2022 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. The U.S. Navy raised concerns about impacts on naval operations from deployment of DAS technology through fiber optic cables in the submarine cable system (BOEM 2021b). Similar to the proposed Project, it is assumed that other future offshore wind project operators would coordinate with the DoD and the U.S. Navy on any proposal to use DAS.

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 2023 through 2030) and decommissioning. Construction periods would likely be staggered, but some overlap is possible. During construction, large vessels with limited maneuverability would deliver components of WTGs, ESPs, and associated equipment to one or more port facilities and to the SWDA. These vessels would operate within restricted navigation channels or be on station during construction activities. 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 and overall future offshore wind vessel activity would be most pronounced during construction and decommissioning time periods, when as many as six offshore wind projects could be under construction simultaneously. Operational traffic associated with each of the other offshore wind projects would 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 903 WTGs with maximum blade tip heights of up to 1,171 feet AMSL to the RI/MA Lease Areas between 2023 and 2030. In addition, stationary and vessel-mounted construction cranes would be used in ports during construction, and WTGs are anticipated to have a temporary height of up to 328 feet during assembly at construction staging areas. 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, along transit routes between ports and construction sites, and locally around ports. These changes could compress lower-altitude aviation activity into more limited airspace in these areas, leading to airspace conflicts or congestion, and increasing collision risks for low-flying aircraft. However, open airspace around the RI/MA Lease Areas would still be available over the open ocean, and ports used for offshore WTG construction would be planned and developed to accommodate tall structures. The addition of WTGs throughout the RI/MA Lease Areas would alter navigation patterns associated with nearby airports, including, but not limited to, Nantucket Memorial Airport. Port improvements and construction activities in or near ports may require alteration of navigation patterns at nearby airports, including, but not limited to, Sikorski Memorial Airport (Bridgeport, Connecticut) and New Bedford Regional Airport. Navigational hazards and collision risks at ports and in transit routes would be reduced as construction is completed, and all navigation hazards and collision risks would be gradually eliminated during decommissioning as offshore WTGs are removed.

All existing stationary structures would have navigation marking and lighting in accordance with FAA (2020) and BOEM (2021a) requirements and guidelines, 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 (COP Volume III, Section 7.9; Epsilon 2022a), as described under National Security and Military Uses. Because the WTGs would be taller than 699 feet, low intensity aviation obstruction lights would be required at mid-tower, in addition to lights on the nacelle (COP Volume III, Section 3.3; Epsilon 2022a). With a maximum vertical extension of 1,171 feet AMSL, the WTG 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 could 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, VFR or IFR operations, airport traffic control cab views, and airport capacities (including impacts resulting from the structure when combined with the impact of other existing or proposed structures) (FAA 2019a). 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 AMSL 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.

For example, the Bay State Wind Project, proposed to be located in OCS-A 0500, received Determinations of No Hazard for WTG blade tips with heights up to 1,049 feet AMSL within U.S. territorial waters (FAA 2019b). The WTGs associated with the Bay State Wind Project were found to exceed obstruction standards of 14 CFR Part 77 in part due to necessary changes in minimum instrument flight altitudes or minimum obstacle clearance altitudes; however, the aeronautical study determined that the project would not have a substantial impact on any existing or proposed arrival, departure, or en-route IFR operations or procedures (FAA 2019b). Similar to the proposed Project, it is assumed that project applicants 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. This coordination would include notification to the FAA of construction activities, and the FAA would issue Notices to Airmen for each vessel movement above a specified height along with Temporary Flight Restrictions associated with WTGs under construction in the SWDA or in transit between ports and the SWDA (COP Volume III, Section 7.9; Epsilon 2022a).

Offshore Cables and Pipelines

Cable emplacement and maintenance: Several other offshore wind projects are currently planned for the RI/MA Lease Areas. Mayflower Wind is the only other project with officially announced plans to install offshore cables within the vicinity of the OECC for the proposed Project. Mayflower Wind currently plans to install its offshore export cables north from Lease Area OCS-A 0521 through Muskeget Channel and Nantucket Sound to a landfall site on Cape Cod's southern shore (AECOM et al. 2021). The applicant for the proposed Project and the applicant for Mayflower Wind would coordinate on any required cable crossings.

Future offshore wind cables would also consider the location of existing cables during routing, including the South Fork Wind, Mayflower, and the Bay Wind State offshore export cables. However, these export cables can be crossed using standard protection techniques during construction, operations, and decommissioning. During proposed 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 reduced during decommissioning of offshore wind farms, as export cables associated with those projects are de-energized and decommissioned and would be eliminated if cables are removed.

Presence of structures: No pipelines were identified within the geographic analysis area. Five existing submarine cables are outside of the SWDA but near the OECC between Martha's Vineyard and Nantucket and Cape Cod. Construction of future wind energy facilities (excluding the proposed Project) would add up to 913 WTGs and ESPs, along with approximately 1,448 miles of OECC and 2,186 miles of inter-array cables and to the RI/MA Lease Areas between 2023 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.

Ongoing maintenance of existing submarine cables would continue into the future, and future offshore wind activities would restrict future cable placement within developed areas of the RI/MA Lease Areas. Future cables may be precluded from all developed areas within the RI/MA Lease Areas after installation of WTGs, ESPs, and inter-array cabling systems due to the density of cables within the SWDA, but future cables could cross the OECCs for these projects using standard protection techniques.

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 903 WTGs with maximum blade tip heights of up to 1,171 feet AMSL to the RI/MA Lease Areas between 2023 and 2030. NOAA NEXRAD weather radar systems are located a sufficient distance from the RI/MA Lease Areas such that radar interference and mitigation would not be anticipated (COP Volume III, Section 7.9, Figure 7.9-1; Epsilon 2022a). Rutgers University indicates that the operational WTGs could affect signals from the Mid Atlantic High Frequency Radar Network (Roarty 2020). Development of offshore wind projects in the RI/MA Lease Areas could incrementally decrease the effectiveness of individual military radar systems if the field of WTGs expands within the radar system's coverage area. In addition, large areas of installed WTGs within the RI/MA Lease Areas could create a large geographic area of degraded radar coverage that could impact multiple radars. Therefore, it is reasonable to assume that future offshore wind facilities could adversely affect NORAD's radar operations and defense of national critical infrastructure located in the same geographic areas (Clearinghouse 2022).

The FAA would evaluate potential impacts on radar systems, as well as mitigation and monitoring measures for those impacts through their review of Form 7460-1 for individual WTGs within U.S. territorial waters (as explained in the National Security and Military Uses discussion) (FAA 2019a). Developers of other offshore wind projects would be required to coordinate with military and national security agencies to identify potential impacts and any mitigation and monitoring measures specific to radar systems, in accordance with FAA Order JO 7400.2M (FAA 2019a). For example, the Bay State Wind Project received Determinations of No Hazard for WTGs with heights of up to 1,049 feet AMSL. Although WTGs associated with the Bay State Wind Project were found to be within the direct line-of-sight for the Falmouth ASR-8, Nantucket ASR-9, and Coventry (Rhode Island) ASR-9 radar systems, the aeronautical study determined that the Bay State Wind Project's WTGs would not have a substantial impact on radar operations at the time of study (FAA 2019b). BOEM assumes that each project applicant would conduct an independent radar analysis, particularly for WTGs outside of U.S. territorial waters, to identify potential impacts and any mitigation and monitoring measures specific to aeronautical, military, and weather radar systems for each WTG analyzed, per BOEM-identified BMPs (Table E-5in Appendix E).[31] BOEM would continue to coordinate with the Clearinghouse to review each proposed offshore wind project on a project-by-project basis and would attempt to de-conflict project concerns identified through such consultation related to military and national security radar systems with COP approval conditions, including concerns related to installation of multiple projects. Impacts on radar systems would gradually decrease during decommissioning as WTGs are decommissioned and removed.

Scientific Research and Surveys

Presence of structures: Construction of other wind energy projects in the RI/MA Lease Areas would add up to 913 WTGs (with blade tip heights of up to 1,171 feet MLLW) and ESPs, associated cable systems, and vessel activity that would present additional navigational obstructions for sea- and air-based scientific surveys. Collectively, these developments would prevent NOAA from continuing scientific research surveys or protected species surveys under current vessel capacities, would affect monitoring protocols in the geographic analysis area, could conflict with state and nearshore surveys, and may reduce opportunities for other NOAA scientific research studies in the area.

This EIS incorporates by reference the detailed summary of and potential impacts on NOAA's scientific research provided in the Vineyard Wind 1 Final EIS (BOEM 2021b) in Section B.3 of Appendix B, Supplemental Information and Additional Figures and Tables. In summary, offshore wind facilities actuate impacts on scientific surveys and advice by preclusion of NOAA survey vessels and aircraft from sampling in survey strata and impacts on the random-stratified statistical design that is the basis for assessments, advice, and analyses. NOAA determined that survey activities within offshore wind facilities are outside of safety and operational limits. Survey vessels would be required to navigate around offshore

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[31] BOEM recommends the following be included in a COP to "demonstrate that the project is being conducted in a manner that confirms to responsible offshore development, to include the use of BMPs, in accordance with 30 CFR 585.621" (BOEM 2020): "Lessees and grantees should 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; they also should identify possible solutions" (BOEM 2020).

wind projects to access survey locations, leading to a decrease in survey precision and operational efficiency. The height of turbines would affect aerial survey design and protocols, requiring flight altitudes and transects to change. Therefore, scientific survey and protected species survey operations would be reduced or eliminated as offshore wind facilities are constructed. If stock or population changes, biomass estimates, or other environmental parameters differ within the offshore wind lease areas but cannot be observed as part of surveys, resulting survey indices could be biased and unsuitable for monitoring stock status. Offshore wind facilities would disrupt survey sampling statistical designs, such as random-stratified sampling. Impacts on the statistical design of region-wide surveys violate the assumptions of probabilistic sampling methods. Development of new survey technologies, changes in survey methodologies, and required calibrations could help to mitigate losses in accuracy and precision of current practices caused by the impacts of wind development on survey strata.

Other offshore wind projects could also require implementation of mitigation and monitoring measures identified in RODs. Identification and analysis of specific measures are speculative at this time; however, these measures could further affect NOAA’s ongoing scientific research surveys or protected species surveys because of increased vessel activity or in-water structures from these projects. BOEM is committed to working with NOAA toward a long-term regional solution to account for changes in survey methodologies as a result of offshore wind farms. The *NOAA Fisheries and BOEM Federal Survey Mitigation Implementation Strategy - Northeast U.S. Region* (Hare et al. 2022) outlines a federal survey mitigation program that will include survey-specific mitigation plans for each affected survey, including both vessel and aerial surveys. Measures from the final, published implementation strategy will be analyzed in the Final EIS.

Overall, planned offshore wind energy projects in the area would significantly affect NOAA’s scientific research and protected species surveys, potentially leading to impacts on fishery participants and communities, as well as potential major impacts on monitoring and assessment activities associated with recovery and conservation programs for protected species.

Marine Minerals

As stated in Section 3.14.1.7, there are no sand resource areas, federal OCS sand and mineral lease areas, or significant sand resource blocks in the geographic analysis area (BOEM-MMIS Undated). Therefore, future marine minerals leasing in this area is unlikely, and conflicts with future offshore wind developments are not expected.

Conclusions

Impacts of Alternative A. Under Alternative A, other uses would continue to follow current regional trends and respond to current and future environmental and societal activities. While the proposed Project would not be built as proposed under Alternative A, ongoing activities would have continuing impacts on other uses, primarily through presence of structures that introduce navigational complexities and vessel traffic.

Cumulative Impacts of Alternative A. In addition to ongoing activities, the impacts of planned activities other than offshore wind would also contribute to impacts on other uses. Planned activities expected to occur in the geographic study area other than offshore wind include increasing vessel traffic, continued residential, commercial, and industrial development onshore and along the shoreline, and continued development of FAA-regulated structures such as communication towers and onshore WTGs. No planned non--offshore wind stationary structures were identified within the offshore portion of the geographic analysis area, and there would be no planned structures to act as navigation hazards or FADs. Planned offshore wind cable activities in the offshore portion of the geographic analysis area include those associated with the South Fork Wind (Lease Area OCS-A 0517) and Vineyard Wind 1 (Lease

Area OCS-A 0501). Any structures exceeding 200 feet AMSL within FAA jurisdiction or otherwise triggering FAA review would be required to submit Form 7460-1 for FAA review, with the DoD and DHS invited to provide input, and BOEM assumes any issues with aviation routes or radar systems would be resolved through this process. Therefore, the impacts of planned activities other than offshore wind would be **negligible** for military and national security uses, aviation and air traffic, cables and pipelines, and radar systems. Impacts of planned activities other than offshore wind on scientific research and surveys would be **minor** due to the lack of proposed development in the RI/MA Lease Areas. The combination of ongoing activities and planned activities other than offshore wind to result in **negligible** impacts on military and national security uses, aviation and air traffic, cables and pipelines, and radar systems, and **moderate** impacts on scientific research and surveys, primarily driven by potential impacts on finfish, invertebrates, and EFH from climate change and fishing.

Considering all the IPFs together, ongoing and planned activities in the geographic analysis area would result in **negligible** to **minor** cumulative impacts for aviation and air traffic and cables and pipelines; **moderate** cumulative impacts on radar systems; **minor** cumulative impacts for military and national security uses except for USCG SAR activities, which would be **major**; and **major** cumulative 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 903 WTGs in the RI/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 guidelines, and by implementing a proposed collaborative regional layout that arranges WTGs in 1-nautical-mile (1.15-mile) × 1-nautical-mile (1.15-mile) grid across the entire RI/MA Lease Areas, and by implementing protocols that would cease WTG operations during SAR activities. Potential risks to military and civilian aviation would be mitigated by the existing FAA review process for structures that exceed 200 feet AMSL within territorial waters, conduct of aeronautical studies by project operators, coordination with military and national security agencies, and implementation of navigational marking of structures according to FAA (2020), USCG (2019), and BOEM (2021a) requirements and guidelines. Installation of WTGs may necessitate navigational route changes at nearby airports.
- No new cables or pipelines except for offshore wind cables would be installed within the geographic analysis area for cables and pipelines. 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.
- The presence of multiple WTGs throughout the RI/MA Lease Areas would potentially affect weather, military, aeronautical, and research radar systems. Identification and mitigation of potential issues with ground-based radar systems are expected to occur through the FAA review process, coordination with military and national security agencies, and independent studies conducted by project applicants.
- 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 and 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 (1.15 miles) from wind installations due to safety and operational challenges.

3.14.2.2 Relevant Design Parameters and Potential Variances in Impacts

The following proposed Project design parameters (Appendix C, Project Design Envelope and Maximum-Case Scenario) would influence the magnitude of impacts on other uses:

- As described in Section 2.1, Alternatives Analyzed in Detail, the final geographic size of Vineyard Wind 1 would define the northeastern border of Phase 1. As a result, the potential footprint of Phase 1 includes a portion of Lease Area OCS-A 0501, as well as portions of Lease Area OCS-A 0534 (Figure 1.1-2). If Vineyard Wind 1 uses its maximum number of spare positions, Phase 1 would be located farther southwest than if Vineyard Wind 1 were to use fewer spare positions.
- Phases 1 and 2 combined would include up to 132 WTGs and ESPs. The number of WTGs in each phase would depend on the generating capacity of the selected WTGs for each phase, which, in turn, depends on the feasibility and commercial availability of WTGs to meet the Phase 1 and Phase 2 construction schedules. WTGs with higher generating capacities would result in a smaller footprint (i.e., fewer positions used), while lower generating capacities would result in a larger footprint. To account for the range in the number of WTGs that may be developed for Phase 1, the potential footprint of Phase 1 overlaps with the potential footprint of Phase 2 (Figure 1.1-2).
- Engineering and environmental constraints could eliminate positions, thereby extending the Phase 1 footprint farther southwest.
- Length, route(s), and final width of cable route.
- The timing of construction and variability in regional port utilization may result in uncertainty regarding which ports may be available during Phase 1 and Phase 2. It is not expected that all the ports identified (Section G.2.7, Land Use and Coastal Infrastructure) would be used; it is more likely that only some ports would be used during construction depending upon final construction logistics planning.
- Decommissioning procedures and co-occurring decommissioning efforts of multiple projects.

The analysis of national security and military use, offshore cables and pipelines, scientific research and surveys, marine minerals, and offshore energy in this section is based on a maximum-case scenario of 130 WTGs. The maximum vertical extension of WTG blade tips is 1,171 feet for both phases of the proposed Project.

3.14.2.3 Impacts of Alternative B – Proposed Action on Other Uses

This section identifies the potential impacts of Alternative B on other uses.

Impacts of Phase 1

Phase 1 would affect other uses through the following primary IPFs during construction, operations, and decommissioning.

National Security and Military Use

Cable emplacement and maintenance: Cable construction vessels associated with Phase 1 could cause military and national security vessels to change route or navigate around temporarily active construction sites above cables. Military and national security vessels would also need to avoid anchoring in hard protection areas for Phase 1 cables. These concerns notwithstanding, impacts on military and national security uses at any one site along the cable route during construction of Phase 1 would be localized, temporary, and **negligible**. To address U.S. Navy concerns about impacts on naval operations, BOEM could require as a condition of COP approval that the proposed Project include distributed fiber optic sensing technology.

Presence of structures: Phase 1 would use stationary lift vessels in the SWDA and cranes in ports during construction. These structures and vessels would add navigational complexity and increase the risk of allision or collision for national security and military vessels, particularly in bad weather or low visibility. The impacts of Phase 1 WTGs on national security and military use (including WTGs under construction or in place prior to operation) are discussed under the Operations and Maintenance and Conceptual Decommissioning subsection. As described in Section 3.13, vessel traffic for Phase 1 would be limited. The applicant and the USCG would provide Offshore Wind Mariner Updates and Notice to Mariners that describe proposed Project-related activities (including the presence of these structures) that may be of interest to military and national security interests. As a result, the impacts of Phase 1 on national security and military use due to the presence of structures would be localized, temporary, and **minor**.

Phase 1 would consist of up to 63 structures (including up to 62 WTGs and 1 or 2 ESPs) in the SWDA in a uniform 1-nautical-mile (1.15-mile) × 1-nautical-mile (1.15-mile) grid. These structures would increase the risk of allision for national security and military vessels that travel through the SWDA, particularly in bad weather or low visibility. In addition, Phase 1 structures could create an artificial reef effect that could attract species of interest to recreational fishing or sightseeing, thereby 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 SWDA is relatively low (17 vessels recorded from 2016 to 2019), and deep-draft military vessels are not anticipated to navigate outside navigation channels unless necessary for SAR operations. Generally, the vessels more likely to allide with WTGs or ESPs would be smaller and 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 would be mitigated by the uniform 1-nautical-mile (1.15-mile) × 1-nautical-mile (1.15-mile) WTG spacing. WTGs and ESPs would be marked as a navigational hazard per FAA (2020), USCG (2019), and BOEM (2021a) requirements, and risk would be consistent within the 30-year operational period. The WTGs would 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. The USCG would need to adjust its SAR planning and search patterns to allow aircraft to fly within the geographic analysis area, leading to a less optimized search pattern and a lower probability of success. This could lead to increased loss of life due to maritime incidents. As part of Phase 1, the applicant would voluntarily implement an operational protocol with the USCG that requires the WTGs to stop rotating within a specified time to mitigate impacts on search and rescue aircraft operating in the SWDA (COP Volume III, Section 7.8; Epsilon 2022a). The applicant would file FAA Form 7460-1 for WTGs located in territorial waters to initiate consultation regarding an FAA hazard determination for Phase 1 (Section 3.14.1.2).

BOEM coordinated with the DoD throughout the leasing area identification process and environmental review process for the RI/MA Lease Areas (BOEM 2014a). During the EIS process for Vineyard Wind 1, USAF identified a concern that WTGs within warning area W-105A, which overlies the majority of the SWDA, could impact the 104th Fighter Wing’s ability to train in W-105A. The USAF indicated that these concerns could be allayed because Vineyard Wind 1 structures would be able to withstand daily sonic overpressures (sonic booms) from supersonic operations, and potentially falling debris from chaff and flare, and assuming the USAF would not be held liable for damage to property or personnel (BOEM 2021b). BOEM assumes that similar conditions would apply to Phase 1 and would continue to work with the USAF, the DoD and national security interests to identify strategies to de-conflict these concerns through conditions of COP approval. The applicant would ensure that a Marine Coordinator remains on duty for the life of Phase 1 to liaise with the military and national security interests to reduce potential conflicts. The DoD found minor but acceptable impacts with Vineyard Wind 1 (BOEM 2021b). As stated above, BOEM will continue to consult with DoD but assumes at this time that DoD's conclusion for Phase 1 would be similar to Vineyard Wind 1. These reviews did not include USCG's activities such as SAR. These impacts are addressed in Section 3.13. Overall, the operations of Phase 1 structures would cause localized, long-term, and **minor** to **moderate** impacts on national security and military use. Specifically, increased navigational complexity and allision and collision risk would have **minor** impacts, while USCG-SAR activities would experience **moderate** impacts due to the reduced probability of successful SAR missions.

The impacts of Phase 1 decommissioning would be similar to those described for construction, and the navigational hazards created by WTGs, ESPs, and stationary vessels would be gradually eliminated during decommissioning as structures are removed.

Traffic: Vessel traffic associated with Phase 1 construction could cause military and national security vessels to change routes and could cause congestion and delays in port and within transit routes. The applicant would coordinate with the U.S. Navy and USCG during construction of Phase 1 to minimize conflicts within the SWDA, along transit routes, and within ports. The offshore components of Phase 1 would be monitored and controlled remotely from the proposed operations facilities. As stated above, the DoD found minor but acceptable impacts with Vineyard Wind 1. BOEM will continue to consult with DoD; however, for analytical purposes in this Draft EIS, BOEM assumes that DoD's conclusion for Phase 1 would be similar to Vineyard Wind 1. The applicant would voluntarily employ a Marine Coordinator for the life of Alternative B to liaise with the military and national security interests to reduce potential conflicts. The applicant and the USCG would provide Offshore Wind Mariner Updates and Notice to Mariners that describe proposed Project-related activities that may be of interest to military and national security interests, including U.S. Navy aircraft and vessels operating within the region. Collectively, these actions would improve safety but would not remove the navigational hazard associated with installing WTGs in the open ocean of the SWDA. As a result, Phase 1 construction would have localized, temporary, and **minor** impacts on military and national security vessel traffic, except for **moderate** impacts on USCG-SAR vessel activity.

As described in Section 3.13, Phase 1 operations vessel traffic would be minimal. These activities would be similar to existing civilian vessel activity in and near the SWDA, and the applicant would comply with coordination requirements. In accordance with the stipulations in Lease OCS-A 0534, the applicant would temporarily suspend operations and evacuate the SWDA if required for national security or defense purposes. Due to limited existing national security and military traffic within the SWDA, operational conflicts are not anticipated within the SWDA. Therefore, impacts on military and national security from Phase 1 would be **negligible** during operations.

Impacts from decommissioning would be the same as the impacts associated with construction, described above: **minor**, except for **moderate** impacts on USCG-SAR vessel activity.

Aviation and Air Traffic

Presence of structures: The impacts of Phase 1 WTGs on aviation and air traffic (including WTGs under construction or in place prior to operation) are discussed under the Operations and Maintenance and Conceptual Decommissioning subsections. Construction of Phase 1 would involve the movement of tall WTG components between ports and the SWDA, as well as construction cranes and other stationary tall equipment within the SWDA. The applicant would file FAA Form 7460-1 for Phase 1 WTGs, as well as for individual structures in territorial waters exceeding 200 feet AMSL, including construction cranes and vessels transiting tall structures between port and the SWDA during construction. The filing would trigger a review to identify and resolve aviation risks through updated aeronautical studies, with consideration of existing obstacles in FAA records. If necessary, the FAA would issue Notices to Airmen for each vessel movement along with Temporary Flight Restrictions associated with WTGs under construction in the

SWDA or in transit between ports and the SWDA (COP Volume III, Section 7.9; Epsilon 2022a). Pilots who choose to fly at lower altitudes over open ocean near the SWDA would have to alter routes to avoid potential collisions with these structures. As a result, Phase 1 construction would result in localized, short-term, and **minor** impacts on aviation and air traffic.

Construction of Phase 1 would add up to 62 WTGs with maximum blade tip heights of up to 1,171 feet AMSL to the SWDA. While the SWDA would be outside of public use and military airport study areas, the Phase 1 WTGs would be “obstructions” pursuant to 14 CFR § 77.17(a)(2) (Obstruction Standard) and 14 CFR § 77.19/21/23 (Imaginary Surfaces), based on their height. As a result, a full aeronautical study must be conducted for Phase 1 (COP Volume III, Appendix III-J; Epsilon 2022a).

The FAA establishes and enforces the following airspace and flight rules and procedures potentially applicable to Phase 1 (COP Volume III, Appendix III-J; Epsilon 2022a):

- VFR traffic pattern airspace or designated VFR routes pursuant to 14 CFR § 77.17(a)(1) that follow recognizable landmarks.
- Instrument departure and approach procedures for routing and climb gradients to and from airports to ensure pilots have sufficient clearance from terrain and obstacles.
- En-route airways are established by the FAA to ensure at least a 1,000-foot obstacle clearance along routes between airports in non-mountainous areas.
- Protection areas for navigational aids.

The Phase 1 WTGs would not interfere with the airspace or procedures described above (COP Volume III, Appendix III-J; Epsilon 2022a).

The FAA establishes minimum vectoring altitudes (MVA) and minimum IFR altitude charts that define the lowest altitude for which air traffic controllers can issue radar vectors due to obstacle clearance. The FAA mandates that sectors have a minimum obstacle clearance of 1,000 feet in non-mountainous areas. Boston Consolidated (A90) Terminal Radar Approach Control (TRACON) MVA sectors, Providence (PVD) TRACON MVA sectors, and Boston (ZBW) Air Route Traffic Control Center minimum IFR altitude sectors overlie the SWDA, with obstacle clearance surfaces ranging from 549 to 4,849 feet AMSL. At 1,171 feet AMSL, the Phase 1 WTGs would exceed some surface heights and would require an increase to a Boston Consolidated (A90) TRACON MVA (COP Volume III, Appendix III-J; Epsilon 2022a).

Pilots who choose to fly at lower altitudes over open ocean near the SWDA would have to alter routes to avoid potential collisions with WTGs. The WTGs would use ADLS; would have navigational markings and lighting pursuant to FAA (2020), USCG (2019), and BOEM (2021a) requirements and guidelines (including the use of ADLS); and would be visible on the radar systems of low-flying aircrafts, similar to other large-scale sea surface activity.

Impacts on military airspace, specifically W-105A, are discussed in the sub-IPF for national security and military use. Impacts on radars involved in managing air traffic are discussed in the sub-IPF for radar systems.

The applicant would file FAA Form 7460-1 for Phase 1 WTGs, as well as for individual structures in territorial waters exceeding 200 feet AMSL, including construction cranes and vessels transiting tall structures between port and the SWDA during construction. The filing would trigger a review to identify and resolve aviation risks through updated aeronautical studies, with consideration of existing obstacles in FAA records.

While Phase 1 WTGs in combination with other existing or proposed tall structures onshore and offshore would increase navigational complexity for aircraft 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 impacts from structures on aviation and air traffic. As appropriate, BOEM would condition COP approval on satisfaction of conditions that FAA imposes for Phase 1 WTGs. Because the SWDA coincides with W-105A, impacts from Phase 1 could be major if the Clearinghouse issues a Notice of Presumed Risk to National Security. Based on previous consultations for Vineyard Wind 1, BOEM does not anticipate such a finding; therefore, impacts on aviation and air traffic from Phase 1 would be localized, long term, and **minor**.

Offshore Cables and Pipelines

Cable emplacement and maintenance: As stated in Section 3.14.2.1, the OECC for the proposed Project could cross the OECC for the Mayflower Wind Project. BOEM assumes that the applicant (or the developer of the Mayflower Wind Project, depending on the timing of cable installation for the two projects) would use standard protection techniques during construction to achieve this cable crossing. As a result, the impacts of Phase 1 on cables and pipelines under this IPF would be localized, temporary, and **negligible.**

Presence of structures: Onshore construction of Phase 1 would not impact offshore cables and pipelines due to lack of spatial overlap with these facilities. Construction of Phase 1 is not likely to pose an allision risk to vessels conducting maintenance activities at existing submarine cables near the SWDA. Such vessels could route around or through the SWDA, but impacts such as allision would be rare due to infrequency of submarine cable maintenance, the limited number of stationary Phase 1 construction vessels, and adherence to required maritime safety procedures. As a result, the impacts of Phase 1 on cables and pipelines under this IPF would be localized, long term, and **negligible**.

While the OECC for Phase 1 does not cross any existing offshore cables or pipelines, the presence of Phase 1’s WTGs, ESPs, and inter-array cabling system within the SWDA could preclude future submarine cable development through the SWDA. Future submarine cables, including future offshore wind export cables, would need to be routed around the SWDA during the operational timeframe. Space use conflicts could be eliminated during decommissioning if structures are removed. Any future crossings of the OECC and new submarine cables could be protected by standard techniques during operations and decommissioning; therefore, overall impacts on cables from Phase 1 operations and decommissioning would be localized, long term, and **negligible**.

Radar Systems

Presence of structures: Construction of onshore facilities associated with Phase 1 is not anticipated to impact radar systems. Phase 1 WTGs could cause interference for ground-based radar. While WTGs in the direct line-of-sight with or extremely close to radar systems can cause clutter and interference, most ground-based radar systems are located a sufficient distance from the SWDA that radar interference is not anticipated, and mitigation would not be required. Phase 1 is outside of the instrumented range for the FAA’s TDWR located at Boston Logan International Airport (COP Volume III, Section 7.9.2; Epsilon 2022a).

The PST long range radar (LRR) analysis accounts for ARSR sites and a few select ASR sites used for air defense and homeland security. The PST LRR analysis does not account for all DoD, DHS, and/or FAA radar sites, including EWR sites. Further, the PST NEXRAD analysis accounts for WSR-88D radar sites but does not account for FAA TDWR radar sites. The PST LRR results show four air traffic control, air defense, and homeland security radar sites—Falmouth ASR-8, Nantucket ASR-9, North ARSR-4, and

Providence ASR-9—in proximity to the SWDA. A basic radar line of sight analysis was conducted for seven radar sites, and analyses identified that the Phase 1 WTGs would be visible to the Falmouth ASR-8 and Nantucket ASR-9 radar sites, would impact the Falmouth ASR-8 (Clearinghouse 2022) and could potentially affect the Providence ASR-9. The analysis indicated that the Phase 1 WTGs would not affect the secondary surveillance radar collocated with the Nantucket ASR-9. Because there are multiple radar sites within approximately 100 nautical miles (115 miles) of the proposed Project area, overlapping coverage in addition to existing efforts by the operator(s) to optimize radar systems would mitigate any potential impacts of Phase 1. The radar line of sight analyses also identified that the Phase 1 WTGs would be visible to and could impact the Cape Cod AFS EWR. As a result, the applicant is consulting with the DoD Siting Clearinghouse on this issue (COP Volume III, Section 7.9.2.1.2; Epsilon 2022a). The applicant expects to enter into an agreement with DoD to mitigate conflicts with or impacts on NORAD radar systems. Anticipated mitigation and monitoring measures are discussed in Appendix H, Mitigation and Monitoring.

For weather radars, a U.S. Department of Energy screening tool for WTG siting did not identify any potential conflicts between Phase 1 and ground-based NOAA NEXRAD weather radars (COP Volume III, Section 7.9.2; Epsilon 2022a). WTGs located in other NEXRAD lines of sight can affect radar reflectivity, internal algorithms that generate alerts and derive weather products, and other attributes and functions. In general, the severity of impacts is related to the separation distance between the WTGs and the NEXRAD facility, with impacts increasing as distance decreases, especially for WTGs located within 11 miles of the NEXRAD facility (COP Volume III, Section 7.9.2.2; Epsilon 2022a). The Clearinghouse review of Vineyard Wind 1 conducted in 2020 stated interference from Vineyard Wind 1 WTGs could adversely affect NORAD radar operations and defense of national critical infrastructure (BOEM 2021b). The SWDA is outside the radar line-of-sight for 3 of the 12 high frequency (HF) radar systems reviewed in this section: the Amagansett HF radar, Moriches HF radar, and the Nauset HF radar, although radar impacts are still possible beyond line-of-sight due to the propagation of HF electromagnetic waves over the ocean surface. Some or all of the WTGs within the SWDA are within the radar line-of-sight for the remaining nine HF radar systems: Block Island Long Range HF radar, Martha’s Vineyard HF radar, Nantucket Island HF radar, Camp Varnum HF radar, Horseneck Beach State Reservation HF radar, Long Point Wildlife Refuge HF radar, Martha’s Vineyard Coastal Observatory Meteorological Mast HF radar, Nantucket HF radar, and the Squibnocket Farms HF radar. For coastal HF radar systems, the applicant would consult with the radar operators and NOAA’s Integrated Ocean Observing System Office to evaluate whether the proposed WTGs are expected to cause radar interference to the extent that radar performance is affected. Additionally, the applicant’s Marine Coordinator would remain on duty for the life of Phase 1 to liaise with military, national security, civilian, and private interests to reduce potential radar conflicts.

The FAA would evaluate potential impacts on radar systems, as well as mitigation and monitoring measures when the applicant files Form 7460-1 for Phase 1 WTGs. The Final EIS will be updated to reflect the outcome of this filing, if available at the time of publication. To address concerns about impacts on radar systems, BOEM could include FAA-recommended mitigation and monitoring measures resulting from the filing of Form 7460-1 (if any) as COP approval conditions. The applicant’s Marine Coordinator would remain on duty for the life of Phase 1 to liaise with military, national security, civilian, and private interests to reduce potential radar conflicts. Pending consultation with the FAA and the Clearinghouse, Phase 1 operations would have localized, long-term, and **moderate** impacts on radar systems.

Scientific Research and Surveys

Presence of structures: Research activities may continue within the proposed SWDA during construction, as permissible by survey operators and boat captains; however, research and survey vessels may need to alter transit routes to avoid construction vessels and other activities. Phase 1 would also impact survey operations by excluding certain areas within the SWDA occupied by proposed Project components (e.g., WTG foundations, cable routes) from potential sampling, and by impacting survey gear performance, efficiency, and availability. Agencies would likely need to expend resources to update scientific survey methodologies due to construction of Phase 1, as well as to evaluate these changes on stock assessments and fisheries management. The applicant would update all relevant parties throughout construction of Phase 1 and would issue Offshore Wind Mariner Update Bulletins and Notices to Mariners regarding Phase 1 related activities. Therefore, the impacts of Phase 1 construction on scientific research and surveys would be **minor** to **moderate**.

Phase 1 would impact scientific research and surveys in the SWDA and greater geographic analysis area. Both BOEM and NOAA have acknowledged that survey methodologies may require updates or changes. BOEM and NOAA are collaborating to design surveys and/or changes in current survey methodology to generate comparable information to the historic dataset. The Other Uses section of the Final EIS for Vineyard Wind 1 provides a detailed summary of NOAA and other research and surveys potentially affected by that project. Those descriptions and impact conclusions are broadly applicable to Alternative B (including Phase 1) and are reprinted in Section B.3 of Appendix B. BOEM and NMFS are working cooperatively on a mitigation strategy to reduce potential impacts on the bottom trawl survey and other surveys from offshore wind facilities (Appendix H). The 1-nautical-mile (1.15-mile) × 1-nautical-mile (1.15-mile) spacing and fixed east-to-west rows and north-to-south columns between WTGs and ESPs in the SWDA would accommodate smaller vessels for surveys through the proposed Project area.

In recognition of the regional importance and nature of fisheries science, the applicant expects to continue working with BOEM and other state and federal agencies, academic institutions, and other stakeholders to continue developing appropriate fisheries studies. The applicant is working with other offshore wind developers, fishing industry representatives and federal and state agencies through its participation with the Responsible Offshore Science Alliance and a Regional Wildlife Science Entity. Additionally, Phase 1 may provide increased opportunities for scientific research and surveys within the geographic analysis area, due to the unprecedented nature of offshore wind projects in the geographic analysis area. These efforts notwithstanding, Phase 1 would have **major** impacts on existing NMFS scientific research and surveys conducted in and around the SWDA because long-standing surveys would not be able to continue as currently designed, and extensive costs and efforts would be required to adjust survey approaches. Phase 1 would also have potential **major** impacts on monitoring and assessment activities associated with recovery and conservation programs for protected species. The loss of precision and accuracy would be a significant hurdle, as new data collection methods are tested and become usable and robust over time. Implementing mitigation and monitoring measures, including the development of survey adaptation plans, standardization and calibration of sampling methods, and annual data collections following new designs and methods would help reduce uncertainty in survey data and associated assessment results and increase the utility of additional data collected as part of any required project-specific monitoring plan.

Impacts on scientific research and surveys from decommissioning would be the same as the impacts associated with construction and would dissipate once WTGs and ESPs are removed. Phase 1 would have **minor** to **moderate** impacts.

Marine Minerals

Construction of Phase 1 would have no impacts on marine minerals, due to the absence of any such resources in the RI/MA Lease Areas, including the SWDA or OECC. Therefore, the impacts of Phase 1 on marine minerals would be **negligible**.

Operations and decommissioning of Phase 1 would not affect future sand and mineral extraction due to the absence of those resources. Therefore, Phase 1 would have **negligible** impacts on marine minerals.

Impacts of Phase 2

The impacts of Phase 2 construction, operations, and decommissioning on other uses would be similar to or the same as described for Phase 1 for IPFs related to cable emplacement and maintenance, the presence of structures, and traffic. Phase 2 would involve the construction, operation, and decommissioning of more WTGs (88 versus 62) and ESPs (up to 3 versus up to 2). The impacts of Phase 2 on national security and military use, aviation and air traffic, offshore cables and pipelines, and scientific research and surveys would be more widespread than described in Phase 1, due to the increased number of WTGs and the increased extent of inter-array cables. The impacts of Phase 2 on radar systems would be reduced compared to Phase 1, due to the increased distance of Phase 2 WTGs from land-based radars. The impacts of Phase 2 on marine minerals would be the same as those of Phase 1.

While the impacts of Phase 2 on other uses would differ from Phase 1 impacts, the incremental differences between Phase 2 and Phase 1 would not change any of the impact magnitudes described for Phase 1 construction, operations, or decommissioning. As a result, the magnitudes of impacts on other uses from Phase 2 would be the same as those described for Phase 1. If the applicant includes the SCV as part of the final proposed Project design, some or all of the impacts on other uses from the Phase 2 OECC through Muskeget Channel would not occur. BOEM will provide a more detailed analysis of the impacts of the SCV and the Phase 2 OECC on other uses in a supplemental NEPA analysis.

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-11 in Appendix G would contribute to impacts on other uses through the primary IPFs of cable maintenance and emplacement and the presence of structures. The installation of up to 1,033 WTGs within the RI/MA Lease Areas would primarily introduce long-term navigational complexity in the region and pose navigational hazards. This would increase allision risks for vessels and collision risks for aircraft and hinder USCG SAR operations across a larger area, potentially leading to decreased likelihood of success, earlier abandonment of search, and resultant increased loss of life.

The cumulative impacts on other uses would result in **minor** impacts for aviation and air traffic; **negligible** impacts for offshore cables and pipelines and marine minerals; **moderate** impacts on radar systems; **minor** impacts for national security and military use except for USCG SAR activities, which would be **major**; and **major** impacts for scientific research and surveys.

Conclusions: Impacts of Alternative B

In summary, Alternative B would impact other uses to varying degrees as described in this section.

National Security and Military Use

Alternative B would have **negligible** to **major** impacts on national security and military use. The WTG and ESPs of Alternative B would cause localized, long-term, and **minor** to **moderate** impacts from allision risk; localized, long-term, and **minor** impacts from allision risks and elevated need for SAR operations due to increased interest to recreational fishing or sightseeing within the SWDA; localized, long-term, and **minor** impacts on most military and national security uses from increased navigational complexity and associated risks, except for **moderate** impacts on SAR operations due to reduced likelihood of success; localized, long-term, and **minor** impacts on military vessels and aircraft from increased space use conflicts; and **negligible** impacts from potential conflict with vessels conducting export cable emplacement and maintenance.

Impacts on military and national security from vessel traffic related to Alternative B would be localized, temporary, and **minor** during construction and decommissioning, and **negligible** during operations. As part of Alternative B, the applicant would voluntarily implement an operational protocol that requires the WTGs to stop rotating within a specified time to mitigate impacts on search and rescue aircraft operating in the SWDA (COP Volume III, Section 7.8; Epsilon 2022a). The applicant would employ a Marine Coordinator to liaise with military and national security interests as needed. These actions would improve safety but would not remove the navigational hazard associated with installing WTGs in the open ocean.

Considering all the IPFs together, Alternative B would result in **minor** impacts on most military and national security uses in the geographic analysis area but **moderate** impacts on USCG SAR operations because a notable and measurable impact is anticipated, but the resource would likely recover completely when the impacting agents were gone and/or remedial or mitigating actions were taken. The main drivers for these impact ratings are the installation of structures, primarily WTGs, within the RI/MA Lease Areas that would hinder USCG SAR operations, leading to increased loss of life. FAA review, coordination with military and national security interests, and other mitigation actions may improve safety of SAR operations, but these mitigation measures would not remove the navigational hazard associated with installing WTGs over a larger area in the open ocean.

Aviation and Air Traffic

Construction, operations, and decommissioning of Alternative B would have **minor** impacts on aviation and air traffic (impacts on military aviation activities are included in the impacts for national defense and military use). Potential impacts on aviation and air traffic would primarily be caused by tall mobile and stationary structures during Alternative B construction and decommissioning, and operation of WTGs in the SWDA, all of which could trigger the need for FAA review and study. This FAA review may identify changes to navigational patterns for local airports. The applicant's Marine Coordinator would liaise with aviation interests to reduce potential conflicts over the life of the proposed Project.

Considering all the IPFs together, Alternative B would result in **minor** impacts on aviation and air traffic because air traffic would be able to continue over and around the RI/MA Lease Areas after any required changes to air traffic navigation patterns are made through established processes.

Offshore Cables and Pipelines

Construction, operations, and decommissioning of Alternative B would have **negligible** impacts on offshore cables and pipelines, due to the absence of existing submarine cables and pipelines in the SWDA and crossing OECC routes. Although future submarine cables, including future offshore wind export cables, would need to be routed around the SWDA, the OECC cables could be crossed using standard techniques to avoid impacts.

Radar Systems

Construction, operations, and decommissioning of Alternative B would have **minor** to **moderate** impacts on radar systems. Although presence of WTGs has the potential to cause interference with radar systems, ground-based radar systems are located a sufficient distance from the SWDA that radar interference is not anticipated and mitigation would not be required, resulting in **minor** impacts. The FAA would evaluate potential impacts on radar systems, as well as mitigation and monitoring measures when the applicant files Form 7460-1 for individual WTGs. The applicant's Marine Coordinator would remain on duty for the life of Alternative B to liaise with military, national security, civilian, and private interests to reduce potential radar conflicts. BOEM would continue to work with military and national security agencies to identify and de-conflict concerns about radar impacts.

Impacts would gradually increase during construction, remain at a stable level during operations, and decrease as multiple project WTGs are decommissioned; therefore, Alternative B would have long-term **moderate** impacts on radar systems; potential conflicts would be addressed through established processes.

Scientific Research and Surveys

Construction, operations, and decommissioning of Alternative B would have **minor** to **major** impacts on scientific research and surveys. During operation of Alternative B, the presence of WTGs, ESPs, and cables would prevent long-standing surveys from continuing as currently designed, and extensive costs and efforts would be required to adjust survey approaches. The inability to continue surveys as currently designed would have a significant impact on monitoring and assessment activities associated with recovery and conservation programs for protected species. Mitigation and monitoring measures such as survey adaptation plans, standardization and calibration of sampling methods, and annual data collections following new designs and methods would help to address some of these concerns, but may not fully address impacts, and such measures would require considerable time and testing to fully implement.

Marine Minerals

Construction, operations, and decommissioning of Alternative B would have a **negligible** impact on marine minerals because no federal OCS sand and mineral lease areas or significant sand resource blocks are located within the SWDA. Similarly, there are no such resources within the RI/MA Lease Areas.

Conclusions: Cumulative Impacts of Alternative B

In summary, Alternative B, when combined with ongoing and planned activities in the geographic analysis area, would affect other uses to varying degrees as described in this section, as follows.

- **National security and military use:** Cumulative impacts of Alternative B would be **minor** on most military and national security uses but **major** on USCG SAR operations. The main drivers for these impact ratings are the installation of structures, primarily WTGs, within the RI/MA Lease Areas that would hinder USCG SAR operations, leading to increased loss of life.
- **Aviation and air traffic:** Cumulative impacts of Alternative B would be **minor**, primarily due to tall mobile and stationary structures during construction and decommissioning, as well as operations of WTGs in the RI/MA Lease Areas.
- **Offshore cables and pipelines:** Cumulative impacts of Alternative B would be **negligible** to **minor**, due to the limited number of cable crossings and the availability of standard protection techniques to achieve these crossings.
- **Radar systems:** Cumulative impacts of Alternative B would be **moderate**. Offshore WTGs in the RI/MA Lease Areas could incrementally decrease the effectiveness of individual radar systems and create a large geographic area of incrementally degraded radar coverage.
- **Scientific research and surveys:** Cumulative impacts of Alternative B would be **major**. The presence of WTGs, ESPs, and cables would prevent long-standing surveys from continuing as currently designed and involve extensive costs and effort to adjust survey approaches. The inability to continue surveys as currently designed would have a significant impact on monitoring and assessment activities for protected species.
- **Marine minerals:** Cumulative impacts of Alternative B would be **negligible** because no federal OCS sand and mineral lease areas or significant sand resource blocks are located within the RI/MA Lease Areas.

3.14.2.4 Impacts of Alternative C – Habitat Impact Minimization Alternative on Other Uses

Alternatives C-1 and C-2 would not affect the number or placement of WTGs or ESPs for the proposed Project compared to Alternative B. Alternatives C-1 and C-2 would alter the exact routes of inter-array, inter-link, and export cables installed for the proposed Project, and could, thus, affect the exact length of cable installed and area of ocean floor disturbed or the exact location of construction or maintenance vessel activity. These differences would not result in meaningfully different impacts compared to Alternative B. Therefore, the impacts of Alternatives C-1 and C-2 on other uses would be the same as those for Alternative B.

3.15 Recreation and Tourism

3.15.1 Description of the Affected Environment

3.15.1.1 Geographic Analysis Area

This section discusses existing recreation and tourism resources and activities within the geographic analysis area, as described in Table D-1 in Appendix D, Geographical Analysis Areas, and shown on Figure 3.15-1. The geographic analysis area includes:

- Massachusetts counties containing onshore export cable infrastructure (Barnstable County for Phases 1 and 2, as well as Bristol County for the Phase 2 SCV);
- The City of Bridgeport, Connecticut, where the operations base would be located; and,
- The geographic analysis area for scenic and visual resources (Section 3.16, Scenic and Visual Resources).

This geographic analysis area allows for review of impacts on offshore recreational activities, recreational resources near the onshore infrastructure and operations base, and visual resources as they relate to recreation and tourism.

Table G.1-18 contains a summary of ongoing and future offshore activities other than offshore wind, which is discussed below.

The geographic analysis area supports ocean-based recreation and tourism: boating, fishing, shellfishing, sightseeing, wildlife viewing, swimming, beach visiting, hiking, and other activities. Recreational boating in the geographic analysis area ranges from ocean-going vessels to small boats used in sheltered coastal waters and includes sailboats, motorboats, kayaks, canoes, and paddleboats. Marine-oriented recreational businesses offer boat rentals, charter fishing, and sightseeing excursions, including trips for viewing whales and other wildlife. Coastal businesses offer hiking, canoe, or kayak tours. Many coastal and ocean amenities that are free for public access function as key drivers for coastal businesses within the recreation and tourism sectors. As discussed in Section 3.11, Demographics, Employment, and Economics, recreation and hospitality are major sectors of the economy in the geographic analysis area, supported by the ocean-based recreation uses.

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.

3.15.1.2 Offshore Recreational Activities

A 2012 survey of marine recreational boat owners in northeast states found the highest density of recreational vessel routes within the geographic analysis area occurred within Nantucket Sound, Vineyard Sound, and Buzzards Bay (Starbuck and Lipsky 2013). In nearby marine areas, highly traveled areas for recreational vessel traffic also occurred within Block Island Sound, Long Island Sound, the Providence River, Boston Harbor, and Salem Harbor. Recreational boating density lessened as the distance from the coast increased.

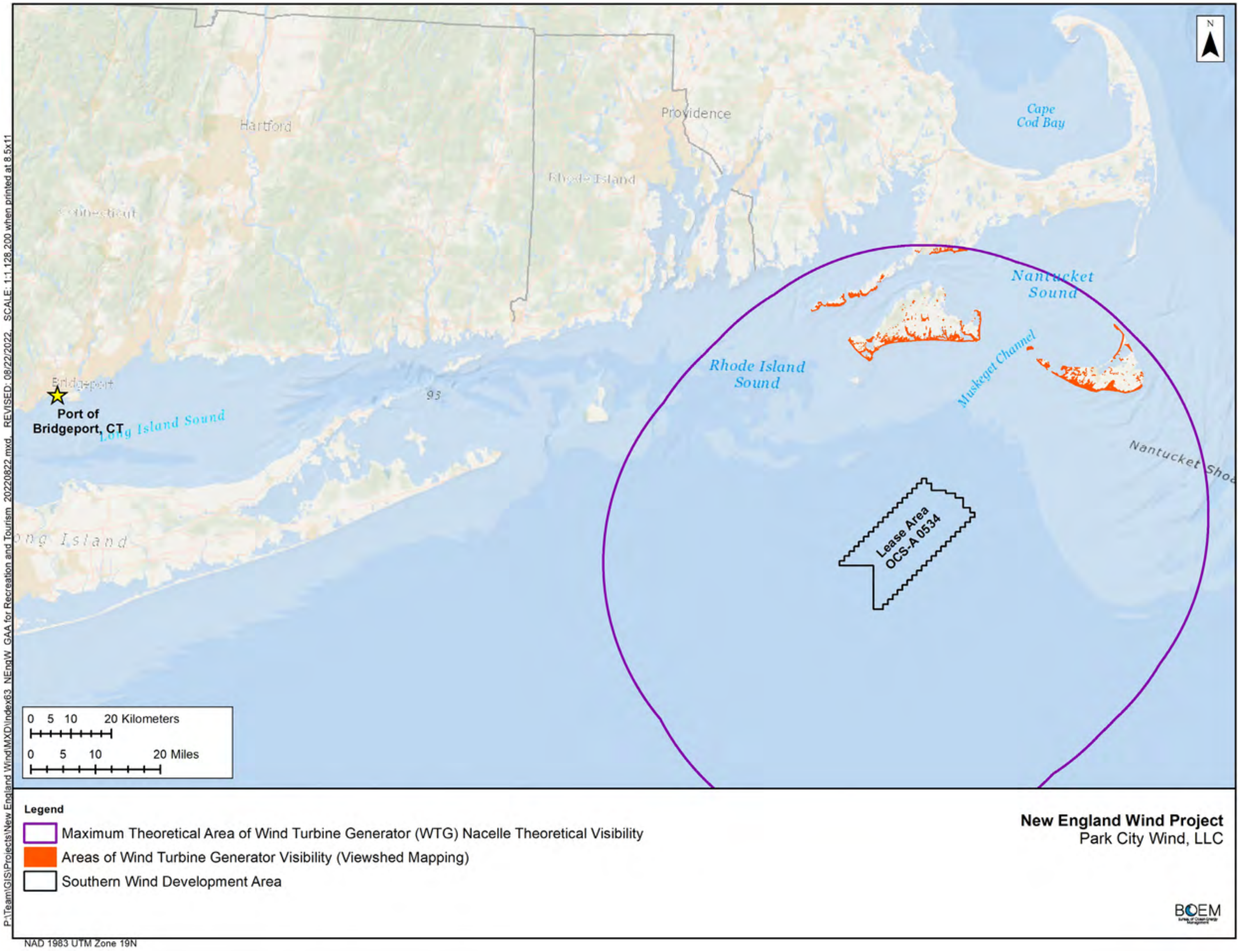

Figure 3.15-1: Geographic Analysis Area for Recreation and Tourism

Generally, along the northeastern coast, more than half (52.4 percent) of recreational boating occurred within 1.2 miles of the coastline (Starbuck and Lipsky 2013). A smaller but still significant proportion of recreational boating occurs farther offshore. A 2020 USCG survey found that 139,000 recreational boats registered or stored in Massachusetts were taken out on the water at least once in 2018, including trips on both inland and marine waters, and 11 percent of these boats, including 26 percent of motorized boats, traveled at least 3 nautical miles (3.5 miles) from the coastline at least once (RTI International 2020).

Recreational boating varies seasonally, with peak boating season occurring between May and September, and includes several types of activities:

- The 2012 survey found that fishing accounted for 43 percent of recreational boating activity off the Massachusetts coast, followed by other (e.g., sightseeing, shellfishing, buying food and supplies; 29 percent), relaxing (19 percent), wildlife viewing (7 percent), and scuba diving or swimming (1 percent each).
- Striped bass was the most commonly targeted fish species within Massachusetts state waters. Outside of state waters, Atlantic cod, Atlantic bluefin tuna, and haddock were the most commonly targeted species.
- Respondents engaging in wildlife viewing most commonly cited birds as the target for viewing (60 percent). Other respondents listed seals (24 percent), whales (7 percent), dolphins and porpoises (6 percent), or sea turtles (1 percent).
- Boating excursions commonly included expenditures at other recreation and tourism-related businesses, including marinas, restaurants, lodging, and entertainment (Starbuck and Lipsky 2013).

In response to questions about recreational boating near other activities, most boaters (58 percent) responded that they could continue to enjoy recreational boating near offshore wind farm turbines, and 53 percent had the same response for recreational boating near ship/tanker/ferry traffic. Boaters ranked port operations and industrial waterfront as the least compatible with recreational boating, with only 44 percent indicating that they could enjoy recreational boating near these uses (Starbuck and Lipsky 2013).

An annual average of almost 2 million private and for-hire angler trips originated in Massachusetts between 2007 and 2012 (Kirkpatrick et al. 2017). An estimated 1.9 percent of the total trips originating in Massachusetts traveled within 1 mile of the RI/MA Lease Areas. Data specific to harbors in the geographic analysis area indicate that 10 percent of private angler trips originating from several locations traveled within 1 mile of the RI/MA Lease Areas, including trips from harbors in Dukes County (Chilmark, Edgartown, Oak Bluffs, and Tisbury), Barnstable County (Falmouth), and Bristol County (New Bedford, Fall River, Fairhaven, and Westport). Regionally, less than 0.5 percent of angler trips originating in Connecticut or New York and 3.6 percent of trips originating in Rhode Island traveled within 1 mile of the RI/MA Lease Areas. Popular HMS fishing locations overlapping with the SWDA include Gordon’s Gully, Fathom Hole, and The Dump (Figure 3.9-2 in Section 3.9, Commercial and For-Hire Recreational Fishing).

Nationally, the Atlantic coast accounted for the majority of marine recreational fishing trips (more than 69 percent) and catch (nearly 63 percent) in 2019 (NOAA 2021c). More than 130 million marine recreational fishing trips originated in Atlantic coast states. About 6 percent of these trips (approximately 7.4 million) originated in Massachusetts, and an estimated 16 percent (about 20.9 million) of fishing trips originated in the nearby states of New York, Connecticut, and Rhode Island. The most commonly caught non-bait species (in numbers of fish) were black sea bass, bluefish, striped bass, summer flounder, and scup. The largest harvests by weight were striped bass, bluefish, scup, mahi-mahi, and black sea bass (NOAA 2021c).

Fishing for Atlantic HMS, defined as federally regulated sharks, blue and white marlin, sailfish, roundscale spearfish, swordfish, and federally regulated tunas, occurs farther offshore than most other recreational fishing and is, therefore, more likely to overlap with areas where future offshore wind development would occur. Federal Atlantic HMS angling permits are issued to a vessel and authorize anyone traveling in that vessel to fish for, retain, or possess federally regulated HMS. In 2016, there were 20,020 permit holders. Fourteen 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 (Hutt and Silva 2019).

A 2020 BOEM study provides a baseline assessment of HMS fishing in southern New England, using an online survey (from August 2019 through May 2020), data from the NMFS Large Pelagics Intercept Survey, and tagging data. The 171 online survey respondents included 136 private anglers, 34 charter/headboat captains, and 1 unknown respondent. All respondents reported using mobile fishing tactics (trolling, drifting, casting/run), and some also reported using stationary tactics (anchoring) to target HMS. Large fleets of 50 to 100 recreational vessels sometimes congregate in small geographic areas when targeting popular HMS (Kneebone and Capizzano 2020).

From 2002 through 2018, approximately 12 percent of HMS trips and 18 percent of tagging events in southern New England occurred within the RI/MA Lease Areas (Kneebone and Capizzano 2020). HMS trips in the lease areas that include the Vineyard Wind 1 and New England Wind Projects[32] represented 1 to 5 percent of total HMS trips in southern New England and 6 to 28 percent of trips in the RI/MA Lease Areas, depending on the year (Kneebone and Capizzano 2020). Trips within the SWDA primarily originated in Massachusetts and Rhode Island. The same was true for the RI/MA Lease Areas overall, although a notable number of trips also originated in Connecticut and New York (Kneebone and Capizzano 2020). The greatest amount of HMS fishing effort occurred west of the RI/MA Lease Areas in the waters south and east of Montauk Point and Block Island.

Numerous sailboat races occur within the geographic analysis area, originating from Nantucket, Martha’s Vineyard, Hyannis on Cape Cod, and other harbors, and generally do not use routes as far offshore as the RI/MA Lease Areas. Long-distance sailboat races with routes as far offshore as the RI/MA Lease Areas may pass through the geographic analysis area depending upon the route selected for a particular year. These races include the Transatlantic Race, Marion to Bermuda Race, and Newport Bermuda Race (COP Volume III, Section 7.5.1.2; Epsilon 2022a).

3.15.1.3 Coastal Communities

The NMFS Social Indicator Map identifies the levels of recreational fishing engagement and reliance in coastal communities. Recreational fishing engagement measures the presence of recreational fishing through fishing activity estimates. Recreational fishing reliance measures the presence of recreational fishing in relation to the population size of a community (NMFS 2021j).

Within the geographic analysis area, the towns of Barnstable and Nantucket rank “High” for recreational fishing engagement, while several towns adjacent to Barnstable rank “Medium High.” Coastal towns within Bristol County (New Bedford, Fairhaven, and Westport) are ranked “Medium” to “Medium High.” For recreational fishing reliance, most of these areas rank “Low,” except for a few towns, including Nantucket, Woods Hole, Falmouth, and West Dennis, which are ranked “Medium.” Bridgeport, Connecticut, is ranked “Low” for recreational fishing engagement and reliance.

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[32] At the time of the study, this was identified as Lease Area OCS-A 0501; it is now identified as OCS-A 0501 and OCS-A 0534.

The towns on Martha’s Vineyard rank “Low” in recreational fishing engagement and reliance.

3.15.1.4 Onshore Recreation

The geographic analysis area incorporates Barnstable, Dukes, Nantucket, Plymouth and Bristol counties in Massachusetts and the City of Bridgeport, Connecticut. These jurisdictions are either in the area where proposed Project structures would be visible or proposed Project onshore facilities would be located.

Barnstable County, comprised of the entirety of Cape Cod, has 550 miles of coastline, mostly sandy beaches, with more than 150 public beaches, several private beaches, and limited access coastal areas. There are approximately 30 harbors, 40 marinas and boatyards, and approximately two dozen private boating and yacht clubs in the county (COP Volume III, Section 7.5.1.1; Epsilon 2022a). Several wildlife sanctuaries in the county, along with the Cape Cod National Seashore, serve as important destinations for onshore wildlife viewing. Cape Cod is a popular tourist destination and depends economically on the recreation and tourism industries (Section 3.11).

The proposed Project’s onshore facilities would be within the Town of Barnstable, the largest of Barnstable County’s 15 municipalities. The Town of Barnstable has 170 miles of coastline, mostly privately owned. Only 9.4 miles of coastline are publicly controlled and available for recreation, and only 2.4 miles are both publicly controlled and easily accessible (Ridley and Associates 2018). The town’s 14 public beaches (11 along the coast and 3 near ponds) account for 133 acres, while public boat landings occupy 12 acres. During the summer, the public beaches are crowded, and beach parking lots frequently reach capacity by mid-morning. Freshwater and marine boating and fishing are popular recreational activities. Shellfishing is a commercially and recreationally significant activity in Barnstable, and the town issued 2,760 recreational shellfishing permits in 2017 (Ridley and Associates 2018).

Inland recreation facilities in the Town of Barnstable include Wequaquet Lake, covering 596 acres. A small town-owned beach and boat ramp are located along the lake’s western edge, adjacent to a portion of Shootflying Road proposed for use for the Onshore Cable Export Route. The town facilities occupy a land area 50 to 150 feet wide between the lake and Shootflying Road, with the public parking area adjacent to the road. A private yacht club is also located adjacent to the lake, about 2,000 feet west of Shootflying Road. Other inland public lands include the Barnstable State Forest, an unimproved, forested, 53-acre tract located about 400 feet east of the West Barnstable Substation (which would be used for proposed Project interconnection to the electric grid) and adjacent to the northern edge of the transmission line ROW that would be a possible route for the proposed Project’s interconnection cable.

Dukes County, which consists of Martha’s Vineyard and other islands south of mainland Massachusetts, has approximately 150 miles of coastline, 15 public beaches, and 6 public boat launch facilities for coastal waters. Dukes County’s only federally protected land is Noman’s Land Island National Wildlife Refuge (COP Volume III, Section 7.5.1.1; Epsilon 2022a). On Martha’s Vineyard, the largest island in the county, approximately 36 percent of the island (20,720 acres) is protected open space, and 38 percent of coastline is open to the general public (Martha’s Vineyard Commission 2010). Recreational boating is supported by five harbors, two marinas, and three yacht clubs (COP Volume III, Section 7.5.1.1; Epsilon 2022a).

Nantucket County has approximately 110 miles of shoreline, of which 80 miles (129 kilometers) are sandy beach open to the public. The Nantucket Wildlife Refuge, a 25-acre tract, is the only federally protected land. Nantucket’s two main harbors, Nantucket and Madaket, are popular seasonal destinations for recreational and commercial vessels. The island also has two yacht clubs, multiple marinas, and two public access boat ramps (COP Volume III, Section 7.5.1.1; Epsilon 2022a).

For both Martha's Vineyard and Nantucket, the coastal landscapes, small towns, fishing fleets, and numerous historical resources provide a character and setting that attract residents, businesses, seasonal residents, and visitors. Numerous lodging facilities, restaurants, short-term housing rentals, and marine recreational services (i.e., charters, tours, and rentals) support tourism.

Bristol County may be selected for Phase 2 landfall sites, onshore export cable routes, and substation sites (Figure 2.1-7). Bristol County has numerous state and local parks along its coastline, including Horseneck Beach State Reservation, Demarest Lloyd State Park, Frank Knowles/Little River Reserve, West Island State Reservation, Fort Phoenix State Reservation, South Shore Marshes Wildlife Management Area, and Nasketucket Bay State Reservation. The Freetown/Fall River State Forest, Southeastern Massachusetts Bioreserve, and Acushnet Cedar Swamp State Reservation occupy substantial inland land area.

The City of Bridgeport, Connecticut, has 24 miles of waterfront on Long Island Sound that includes two harbors: Black Rock Harbor and Bridgeport Harbor. The waterfront has historically been dominated by industrial uses but also includes residential areas and recreational uses, such as parks, private marinas, yacht clubs, and recreational marine services. The historic Seaside Park, with 2.5 miles of coastline, provides beaches and other recreational space. The city's plans seek to increase public access and recreational use of the waterfront, including new pathways, parkland, and recreational facilities, complemented by mixed-use commercial and residential development (City of Bridgeport 2017, 2019).

3.15.2 Environmental Consequences

Definitions of impact levels for recreation and tourism are described in Table 3.15-1.

Table 3.15-1: Impact Level Definitions for Recreation and Tourism

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on the recreation setting, recreation opportunities, or recreation experiences would be so small as to be unmeasurable.
	Beneficial	No impact or measurable impact.
Minor	Adverse	Impacts would not disrupt the normal functions of the affected activities and communities.
	Beneficial	A small and measurable improvement to infrastructure/facilities and community services or benefit for tourism.
Moderate	Adverse	The affected activity or community would have to adjust somewhat to account for disruptions due to the proposed Project.
	Beneficial	A notable and measurable improvement to infrastructure/facilities and community services or benefit for tourism.
Major	Adverse	The affected activity or community would have to adjust to significant disruptions due to large local or notable regional adverse impacts of the proposed Project.
	Beneficial	A large local, or notable regional improvement to infrastructure/facilities and community services or benefit for tourism.

3.15.2.1 Impacts of Alternative A – No Action Alternative on Recreation and Tourism

When analyzing the impacts of Alternative A on recreation and tourism, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on existing conditions for recreation and tourism (Table G.1-12 in Appendix G, Impact-Producing Factor Tables and Assessment of Resources with Minor [or Lower] Impacts). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for recreation and tourism described in Section 3.15.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on recreation and tourism include other offshore wind projects that would be built to meet the state demand for additional electricity. Therefore, impacts from ongoing, future offshore wind activities, as well as future non-offshore wind activities, would still occur (Table G.1-18). The impacts on recreation and tourism would be similar, but the exact impacts would not be the same due to temporal and geographical differences. Visitors would continue to pursue activities that rely on the area's coastal and ocean environment, scenic qualities, natural resources, and establishments that provide services for recreation and tourism. While the geographic analysis area has a strong tourism industry and abundant coastal and offshore recreational facilities, many of which are associated with scenic views, local jurisdictions face challenges maintaining the recreational resources. The primary concern for the ocean-based resources is protection of water quality. The following analysis addresses planned offshore wind projects that fall within the geographic analysis area and considers the assumptions included in Appendix E.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on recreation and tourism include continued operations of the Block Island Wind Farm and ongoing construction of Vineyard Wind 1 in OCS-A 0501 and the South Fork Wind Project in OCS-A 0517. Ongoing operations of the Block Island Wind Farm and ongoing construction of Vineyard Wind 1 and South Fork Wind Project, along with planned offshore wind activities, would affect recreation and tourism through the primary IPFs described below.

Cumulative Impacts

The cumulative impact analysis for Alternative A considers the impacts of Alternative A in combination with other planned non-offshore wind activities and planned offshore wind activities (other than Alternative B). Future offshore wind activities would 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 noise and presence of structures IPFs) are based on state demand within the RI/MA Lease Areas being met using the greatest number of foundations and WTGs, resulting in construction and operation of up to 913 WTGs and ESPs (Appendix E).
- Impacts on recreation and tourism due to the impacts of visible offshore wind structures, specifically WTGs, are based on state demand within the RI/MA Lease Areas being met using the smallest number of foundations and WTGs (and, therefore, the tallest WTGs), resulting in construction and operations of up to 903 WTGs visible from locations onshore (Appendix E).

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

Increased vessel anchoring during development of future offshore wind would affect recreational boaters. The greatest volume of anchored vessels would occur in offshore work areas during construction. The applicant conservatively estimates that an average of 30 and a maximum of 60 vessels would be present at the SWDA at any given time during construction, including an average of 7 and maximum of 15 vessels used for cable-laying activities along the OECC in any 1 month (COP Volume III, Section 7.8.2.1; Epsilon 2022a). Future offshore wind projects may generate similar numbers of active and/or anchored vessels, depending on project size and construction schedule. Anchored construction-related vessels within 12 nautical miles (13.8 miles) of the shore may be within temporary safety zones established in coordination with the USCG for active construction areas (COP Appendix III-I, Section 11.1; Epsilon 2022a). Future offshore wind development in the geographic analysis area is anticipated to result in increased survey activity and overlapping construction periods beginning in 2022, with as many as six projects (not including the proposed Project) under construction at one time in 2025, with others in surveying, permitting, or operational stages.

Vessel anchoring would also occur during operations. Following construction of future offshore projects (if approved), the presence of ten 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 would be able to 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 3.6, Finfish, Invertebrates, and Essential Fish Habitat) and sightseeing (whales, 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.

Cable emplacement and maintenance: Under Alternative A, future offshore wind export cables from offshore wind projects in the RI/MA Lease Areas could cross 1,488 miles, while inter-array cables could total 2,186 miles (Appendix E). Cable emplacement for other future offshore wind projects would likely occur between 2022 and 2030. Based on the assumptions in Appendix E, offshore export cables, inter-array cables, and inter-link cables for the offshore wind projects in the RI/MA Lease Areas could affect up to 21,975 acres.

Offshore cable emplacement for future offshore wind development projects would have temporary, localized, impacts on recreational boating while cables are being installed. Vessels would need to navigate around work areas, and recreational boaters would likely prefer to avoid the noise and disruption caused by installation. Cable installation could also have temporary impacts on fish and invertebrates of interest for recreational fishing, due to the required dredging, turbulence, and disturbance; however, species would recover upon completion (Section 3.6). Active work and restricted areas would only occur over the cable segment being emplaced at a given time. Once onshore cables are installed, periodic maintenance could also generate temporary work areas, noise, and disruption. Cables from other offshore wind projects would result in an increased number of maintenance needs.

Impacts of cable emplacement on recreational boating and tourism would be short term in a given area, but continuous, and localized. Impacts of cable maintenance would be short term, infrequent, and localized. Cable removal during decommissioning would have impacts similar to cable installation: localized and temporary.

Lighting: Construction of future offshore wind projects could result in additional vessel lighting within multiple work areas in the RI/MA Lease Areas, with as many as seven offshore wind energy projects under construction at one time between 2022 and 2030 (Appendix E), but little of this lighting would be visible from coastlines. Construction-related nighttime vessel lighting would be used if future offshore wind development projects include nighttime, dusk, or early morning construction or material transport. In a maximum-case scenario, lights could be active throughout nighttime hours for up to six future offshore wind projects (other than the proposed Project) 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.

Aviation warning lighting required on the WTGs would be visible from south-facing beaches and coastlines within the geographic analysis area and could have impacts on recreation and tourism in certain locations if the lighting influences visitor decisions in selecting coastal locations to visit. At night, required aviation lighting on the WTGs would consist of red lights on the nacelle flashing 30 times per minute and mid-tower red lights flashing at the same frequency. Warning lighting from up to 903 WTGs could theoretically be visible within the geographic analysis area, depending on viewer location, intervening vegetation, and topography and atmospheric conditions.

A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use found that WTGs visible more than 15 miles from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity (Parsons and Firestone 2018). The study participants viewed visual simulations of WTGs in clear, hazy, and nighttime conditions (without ADLS). A 2017 visual preference study conducted by North Carolina State University evaluated the impact of offshore wind facilities on vacation rental prices. The study found that nighttime views of aviation hazard lighting (without ADLS) for WTGs close to shore (5 to 8 miles) would adversely impact the rental price of properties with ocean views (Lutzeyer et al. 2017). It did not specifically address the relationship between lighting, nighttime views, and tourism for WTGs 15 or more miles from shore. More than 95 percent of the WTG positions envisioned in the geographic analysis area would be more than 15 miles from coastal locations with views of the WTGs.

In addition to recreational fishing, marine wildlife-viewing is an important recreational activity. A 2013 BOEM study evaluated the impacts of WTG lighting on birds, bats, marine mammals, sea turtles, and fish. The study found that existing guidelines “appear to provide for the marking and lighting of [WTGs] that will pose minimal if any impacts on birds, bats, marine mammals, sea turtles or fish” (Orr et al. 2013). By extension, WTG lighting subject to existing lighting guidelines or ADLS would not affect recreational fishing or wildlife viewing.

As a result, although lighting on WTGs would have a continuous, long-term 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.

The applicant proposes the use of ADLS for the proposed Project (COP Volume III, Section 2.2.1 and 2.3.1; Epsilon 2022a). ADLS would only activate WTG lighting when aircraft enter a predefined airspace. For the proposed Project, this was estimated to occur 235 times during the year, for a total of 9 to 13 minutes annually (less than 0.1 percent of annual nighttime hours) (COP Appendix III-K; Epsilon 2022a). When implemented for other wind energy projects in the RI/MA Lease Areas, 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. This would significantly reduce the already minimal impacts on recreation and tourism associated with lighting on WTGs.

Noise: Noise from future wind development construction, pile driving, G&G survey activities, trenching, operations, and vessels could result in impacts on recreation and tourism.

Onshore construction noise from cable installation at the landfall sites (near public beaches) 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, especially 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 and cause boaters to avoid areas of noise-generating activity. For construction within 12 nautical miles (13.8 miles) of the coast, the USCG would establish safety zones that would be off-limits to boaters and encompass the areas of the most intense noise from OECC installation.

Noise modeling for the Block Island Wind Farm (an existing, five-turbine facility located about 50 miles west of the proposed Project) predicted that pile driving, the noisiest aspect of WTG installation, would generate noise estimated at 60 A-weighted decibels (dBA) experienced by boaters at a distance of 1 nautical mile (1.15 miles) from the construction zone (Tetra Tech 2012), comparable in volume to the noise level of a normal conversation (OSHA 2011; CDC 2019). Pile-driving noise would be produced intermittently during construction of each project for several hours per foundation for the installation of no more than two foundations per day (COP Volume I, Section 3.3.1.4; Epsilon 2022a). One or more projects may install up to two foundations per day, either sequentially or simultaneously from 2022 to 2030 (Table E-1), and pile driving would likely occur during the same months that recreational boating is most popular (May through October). Lower levels of construction-related noise from other construction activities and along the OECC would result in lower levels of noise that recreational boaters are also likely to avoid.

For operations, measurement of sound generation from wind energy systems in Europe that are similar to 8 to 10 MW turbine systems indicated that sound levels in the 100 to 120 dBA range may be experienced at the source (directly at the operating turbine) but attenuate rapidly to a level of less than 50 dBA at a distance of 0.5 nautical mile (0.57 mile) from the source (CHC 2018). Similarly, Block Island Wind Farm modeling predicted noise levels at the turbine exceeding 50 dBA but typically falling to less than 50 dBA at 0.5 nautical mile (0.57 mile) and less than 40 dBA at 1 nautical mile (1.15 miles) (Tetra Tech 2012). Maintenance operations could temporarily produce localized vessel and equipment noise.

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

Species important to recreational fishing and sightseeing within the RI/MA Lease Areas and along OECC routes may be affected, as discussed in Section 3.6; Section 3.7, Marine Mammals; and Section G.2.4, Birds. G&G survey noise and pile driving would cause the most impactful noises. Recreational fishing for HMS such as tuna, shark, and marlin are more likely to be affected, as these fisheries are farther offshore than most fisheries and, therefore, 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 impacts on marine sightseeing that relies on the presence of mammals, primarily whales. However, as noted in Section 3.7, BMPs can minimize exposure of individual mammals to harmful impacts and avoid measurable, population-level impacts.

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

Based on the discussion above, future offshore wind construction would result in short-term and localized impacts on recreational fishing and marine sightseeing, due to offshore construction-related noise, as well as temporary impacts on 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 (Appendix E) indicates the possibility of up to six wind projects (excluding the proposed Project) simultaneously under development in the RI/MA Lease Areas and up to 913 WTGs and ESPs installed from 2022 to 2030 in the RI/MA Lease Areas.

No long-term impacts are anticipated from noise, provided that mitigation and monitoring measures are implemented to prevent population-level harm to fish and marine mammal populations.

Port utilization: The geographic analysis area for recreation and tourism incorporates existing or potential ports at Bridgeport, New Bedford, Brayton Point, Fall River, and Vineyard Haven Harbor, which are anticipated to be used to support future offshore wind construction and operations. Additional ports outside the geographic analysis area for recreation and tourism may be used for staging and construction. Some of these ports also provide facilities for recreational vessels, and most of the ports are on waterways or within harbors shared with recreational docks and marinas. Recreational and industrial marine traffic would continue to share waterways during offshore wind development. Port improvements requiring construction or dredging could result in short-term displacement and disruption to recreational vessels but could also provide long-term benefits 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 913 WTGs and ESPs within the RI/MA Lease Areas would be the maximum-case scenario for recreational fishing and boating. Future offshore wind structures would be added intermittently in the RI/MA Lease Areas from 2022 to 2030, and these structures would remain until decommissioning of each facility is complete (up to 30 years from installation). The geographic extent of impacts from planned offshore wind development would increase as additional offshore wind projects are constructed. The offshore structures would have long-term 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.

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/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. Navigational risks are described in more detail in Section 3.13, Navigation and Vessel Traffic.

Future offshore wind development could require adjustment of routes for recreational boaters, anglers, sailboat races, and sightseeing boats, but the impact of the future offshore wind structures on recreational boating would be limited by the distance offshore. The closest WTG—a WTG position within Lease Area OCS-A 0486, as viewed from Squibnocket Beach South (Appendix I, Seascape and Landscape Visual Impact Assessment)—could be about 10.6 miles from shore. The 2012 survey of recreational boaters along the northeastern United States coast, discussed in Section 3.15.1, found that more than half (52 percent) of recreational boating occurred within 1.2 miles of the coastline (Starbuck and Lipsky 2013). The 2020 USCG data found that only 11 percent of recreational vessels traveled more than 3 miles off the coastline in 2018 (RTI International 2020). Most recreational vessels would continue to navigate within 3 miles of shore and would not interact with offshore WTGs or ESPs. The owners of relatively large recreational vessels surveyed by Dalton et al. (2020) confirm the general preference for boating closer to the coast than the RI/MA Lease Areas.

Recreational boating farther from shore would be affected by the presence of future offshore wind structures. Examples include recreational fishing (especially HMS fishing), sightseeing boats, and large sailing vessels, including sailboat races. As noted in Section 3.15.1, data from 2002 through 2018 indicates that recreational HMS fishing activity occurs within the RI/MA Lease Areas, although the greatest volume of HMS fishing activity in southern New England is west of the RI/MA Lease Areas. HMS fishing within the proposed Project lease area and the adjacent Vineyard Wind 1 lease area accounted for up to 5 percent of HMS trips in southern New England and up to 28 percent of HMS trips in the RI/MA Lease Areas (Kneebone and Capizzano 2020). Commonly used mobile methods for HMS angling such as trolling and drifting may be incompatible with the presence of WTGs and ESPs, depending on weather conditions and specific techniques. For example, trolling may involve trailing many feet of lines and hooks behind the vessel and then following large pelagic fish once they are hooked; this could result in navigational and maneuverability challenges around WTGs. These concerns notwithstanding, habitat conversion resulting from the presence of WTG and ESP structures would also benefit recreational fishing (Section 3.9).

Several long-distance sailboat races may pass through the geographic analysis area, depending on the route selected for a particular year, including the Transatlantic Race, Marion to Bermuda Race, and Newport Bermuda Race (COP Volume III, Section 7.5.1.2; Epsilon 2022a). Larger sightseeing boats travel to offshore locations where whale sightings are 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 would need to avoid WTGs and would likely choose to avoid future offshore wind projects altogether.

The RI/MA Lease Areas would have an estimated 913 foundations with 7,170 acres of scour protection, along with 1,315 acres of hard protection for offshore export, inter-array, and inter-link cables (some of which may be outside of the geographic analysis area for recreation and tourism), which results in an increased risk of recreational fishing gear loss or damage by entanglement. The cable protection would also present a hazard for anchoring, as anchors could have difficulty holding or become snagged and lost. Accurate marine charts could make operators of recreational vessels aware of the locations of the cable protection and scour protection. If the hazards are not noted on charts, operators may lose anchors, leading to increased risks associated with drifting vessels that are not securely anchored. Buried offshore cables would not pose a risk for most recreational vessels, as anchors from smaller vessels would not penetrate to the target burial depth (6 to 8 feet) for the cables. Because anchoring is uncommon in water depths where WTGs would be installed, anchoring risk is more likely to affect 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 to fish within the RI/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 RI/MA Lease Areas. Additional fishing and tourism activity generated by the presence of structures could also increase the likelihood of allisions and collisions involving recreational fishing or sightseeing vessels (Section 3.13).

A 2020 study examined reactions of recreational boaters to potential offshore wind development in the RI/MA Lease Areas. The study was based on a survey of 2,500 recreational boaters using ports in Rhode Island, evenly split between sailing and motor vessels (including vessels greater than 5 net tons or at least 26 feet in length) (Dalton et al. 2020). Survey respondents tended to prefer boating closer to the coast, south of Newport and near Block Island, as opposed to near the RI/MA Lease Areas. The survey found that boating within 100 feet of an offshore wind facility would detract considerably from a boater’s experience. However, boaters who fished expressed less negative impact from boating near a turbine than those who do not fish, and recreational fishing boaters expected to catch more target species. The study concluded that a wind energy facility in the RI/MA Lease Areas would be unlikely to have significant impacts on recreational boaters because many boaters prefer to use waters closer to the coast, most recreational boaters from Rhode Island ports who choose to visit the RI/MA Lease Areas would likely keep their distance from new structures, and increased abundance of targeted fish species near offshore wind facilities would have beneficial impacts on recreational fishing (Dalton et al. 2020).

The visual impacts of WTGs may also affect recreation and tourism (Section 3.16). Sightseeing excursions to observe the WTGs would benefit the recreation/tourism experience. However, if experiencing a vast pristine ocean condition is the purpose of the viewer's sightseeing excursion, then the visual dominance of WTGs and ESPs may detract from the viewer's recreation/tourism experience.

Studies and surveys evaluating the impacts of offshore wind facilities on tourism have found that established offshore wind facilities in Europe did not decrease tourist numbers, experience, or revenue (Smythe et al. 2018). A survey-based study, detailed as follows, found that for prospective offshore wind facilities (based on visual simulations), proximity of WTGs to shore correlated with the share of respondents who would expect a worsened experience visiting the coast (Parsons and Firestone 2018):

- At a distance of 15 miles, 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 offshore, 6 percent when 15 miles offshore, and 5 percent when 20 miles offshore; and
- 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 anticipated that offshore wind development would have an adverse impact.

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, WTGs would add a contrasting visual element to ocean views that are currently characterized by open ocean (Section 3.16). Based on the available studies, portions of 1,013 WTGs associated with Alternative A could be visible from shorelines (depending on vegetation, topography, atmospheric conditions, and the viewers' visual acuity), of which up to 50 (fewer than 5 percent) would be within 15 miles of shore (Appendix E). Based on the research cited above on the relationship between visual impacts and recreational experience impacts, the impact of visible WTGs on recreation and tourism would be long term and continuous for a limited number of locations. 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 affect shore-based or marine 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 operations 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 unknown; however, as an example, the proposed Project is projected to generate an average of 6 or 7 daily vessel trips between ports and offshore work areas over the entire construction stage and up to 15 vessel trips daily during peak construction activity (COP Volume III, Section 7.8.2.1.1; Epsilon 2022a). As shown in Appendix E, as many as six offshore wind projects (not including the proposed Project) could be under construction simultaneously in 2025. During such periods, construction of offshore wind projects would generate an average of 48 to 56 vessel trips daily from Atlantic coast ports to worksites within the geographic analysis area.

Up to ten future offshore wind projects could be constructed in the RI/MA Lease Areas between 2022 and 2030 (Appendix E). Operations for the proposed Project are anticipated to generate an average of one to two vessel round trips per day (two to four one-way trips) between a port and the SWDA for observation, with additional vessel trips occurring as needed for repair and maintenance activities. Based on the estimates for the proposed Project, Alternative A would generate an average of 10 to 20 vessel trips per day during operations.

Increased vessel traffic would require increased alertness on the part of recreational or tourist-related vessels and could 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 and variable 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.

Conclusions

Impacts of Alternative A. Under Alternative A, existing conditions for recreation and tourism would continue to follow current regional trends and respond to ongoing non-offshore wind and offshore wind activities. Other offshore wind projects that could affect the same geographic analysis area for recreation and tourism would be built to meet the state demand for additional electricity that the proposed Project would have provided. While the proposed Project would not be built under Alternative A, ongoing activities would have continuing impacts on recreation and tourism, the overall impacts of Alternative A combined with ongoing activities would result in **moderate** impacts and **minor** beneficial impacts.

Cumulative Impacts of Alternative A. Future offshore wind activities are expected to contribute considerably to several IPFs, the most prominent being noise and traffic during construction and the presence of offshore structures during operations. Noise and traffic would have impacts on visitors who may avoid onshore and offshore noise sources and vessels and 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. The cumulative impacts of Alternative A would be **moderate**, along with **minor** beneficial impacts due to the presence of offshore structures and cable hard cover, which could provide opportunities for fishing and sightseeing.

3.15.2.2 Relevant Design Parameters and Potential Variances in Impacts

The following proposed Project design parameters (Appendix C, Project Design Envelope and Maximum-Case Scenario) would influence the magnitude of the impacts on recreation and tourism:

- The exact number of WTGs and ESPs and height of WTGs. A larger number of WTGs would result in the greatest impact on recreational vessel navigation. Taller WTGs would have greater impacts on scenic and visual resources (Section 3.16), increasing the impact on visual components of recreation and tourism.
  - Phase 1 and Phase 2 would include up to 132 foundations (including 10 positions reassigned from Vineyard Wind 1, as described in Section 2.1.2). This would up to 62 WTGs for Phase 1 and up to 88 WTGs for Phase 2.
  - WTGs for Phase 1 and Phase 2 would have a maximum nacelle-top height of 725 feet MLLW and a maximum blade tip height of 1,171 feet MLLW (Appendix C).
- The time of year during which onshore and near shore construction occurs. Tourism and recreational activities in the SWDA tend to be higher from May through September, and especially from June through August.
- The location of Phase 2 landfall sites, onshore export cable routes, and substations in relation to recreational resources.

3.15.2.3 Impacts of Alternative B – Proposed Action on Recreation and Tourism

This section identifies potential impacts of Alternative B on recreation and tourism.

Impacts of Phase 1

Phase 1 would affect recreation and tourism through the following primary IPFs during construction, operations, and decommissioning.

Anchoring and gear utilization: Anchoring by vessels during Phase 1 would contribute to disturbance of marine species and inconvenience to recreational vessels that must navigate around the anchored vessels. Phase 1 would deploy 7 to 15 vessels monthly along sections of the OECC during cable installation activities, although these vessels may not all be deployed at the same time (COP Volume III, Section 7.8.2.1.1; Epsilon 2022a). During the construction stage, an average of 30 vessels (up to 60 vessels during the period of maximum activity) would be present in the SWDA or OECC at any one time. Some anchored vessels within 12 nautical miles (13.8 miles) of the coast could be within a temporary safety zone established by the USCG (COP Appendix III-I, Section 11.1; Epsilon 2022a). Vessel anchoring for Phase 1 construction would have localized, short-term, and **minor** impacts on recreation and tourism due to the need to navigate around vessels and work areas and the disturbance of species important to recreational fishing (Section 3.6).

An average of 5 and up to 15 vessels are anticipated to be operating within the SWDA daily for Phase 1 (COP Volume III, Section 7.8.2.2.1; Epsilon 2022a). More vessels may be needed for certain maintenance or repair scenarios. The Phase 1 operational vessel anchoring within the SWDA would have localized, long-term, and **negligible** impacts on recreation and tourism. Anchoring of Phase 1 vessels during decommissioning would have the same impacts as the anchoring needed for Phase 1 construction: localized, short-term, and **minor** impacts on recreation and tourism from Phase 1.

Cable emplacement and maintenance: Installation of offshore cables would temporarily restrict access to the OECC route. An average of 7 cable-laying, support, and crew vessels and a maximum of 15 vessels may be deployed along sections of the OECC during construction activities (COP Volume III, Section

7.8.2.1.1; Epsilon 2022a). Vessels are likely to remain at the same location for several days. Recreational vessels traveling near the route of the OECC would need to navigate around vessels and access-restricted areas associated with OECC installation. In addition, the OCEC route crosses the routes for commercial ferry services operating out of Hyannis, Martha's Vineyard, and Nantucket, important to tourism and area residents. As noted in Section 3.13, numerous means would be used to communicate with mariners regarding construction-related marine activities. The localized, temporary need for changes in recreational and tourism-related navigation routes due to Phase 1 cable emplacement and maintenance would constitute a **minor** impact.

Cable installation along the OECC and within the SWDA could also affect fish and mammals of interest for recreational fishing and sightseeing through dredging and turbulence, although species would recover upon completion (Sections 3.6 and 3.7), resulting in localized, short-term, and **minor** impacts on recreation and tourism.

Onshore construction would affect recreation and tourism at the landfall site. The Phase 1 landfall site at Covell's Beach or Craigville Beach would experience disturbance during installation of the cable onshore/offshore transition vaults, as well as HDD or trenching in preparation for joining the onshore and offshore cables. Construction would prevent the use of part of the beach parking lot and discourage beach visitation due to noise and activity. These impacts would be unavoidable during construction but temporary. The applicant would not perform activities at the landfall site during the months of June through September, unless authorized by the host town. Onshore construction would have temporary, localized, and **moderate** impacts on recreation and tourism at the landfall site.

The onshore export cable route would be within the ROW of Shootflying Hill Road, where the road provides access to the Town of Barnstable's beach and boat ramp for Wequaquet Lake. The noise and pavement disturbance during cable installation would result in temporary noise and disturbance for the recreation facilities, with short-term and **negligible** impacts on the recreational resource.

Offshore cable emplacement and maintenance would require infrequent vessel traffic and trenching. Recreational vessels traveling near the route of the OECC would need to navigate around vessels and access restricted areas associated with OECC maintenance. Onshore cable emplacement and maintenance at the landfall site and under public beaches and parking lots would disturb beach enjoyment and parking. The localized, temporary disturbance to marine recreation and beach use due to cable emplacement and maintenance would have short-term, infrequent, and **minor** impacts on recreation and tourism.

Cable removal during decommissioning would have impacts similar to cable installation: localized, temporary, and **minor** impacts on recreation and tourism from Phase 1.

Lighting: When nighttime construction occurs, the vessel lighting for vessels traveling to and working at Phase 1 offshore construction areas may be visible from onshore locations depending on the distance from shore, vessel height, and atmospheric conditions. Visibility would be sporadic and variable. Although most construction would occur during daylight hours, construction vessels would use work lights to improve visibility during nighttime or poor visibility, in accordance with USCG requirements. Work lights are generally directed downward and would not typically be visible from shore (COP Appendix III-H.a; Epsilon 2022a). Due to the limited duration, frequency, and intensity of such lighting as viewed from coastlines, visible construction-related vessel lighting for Phase 1would result in a short-term, intermittent, and **negligible** impact on recreation and tourism.

During operations, Phase 1 would generate nighttime lighting due to required aviation hazard lighting on WTGs. Hazard lighting from Phase 1 WTGs could be visible from south-facing coastlines and elevated locations on Martha's Vineyard, Nantucket, and neighboring islands, depending on vegetation, topography, and atmospheric conditions (COP Appendix III-H.a, Section 5.2.1; Epsilon 2022a). The applicant has committed to implement ADLS that would activate the WTG lighting only when aircraft approach Vineyard Wind 1 WTGs, which is expected to occur less than 0.1 percent of annual nighttime hours. Due to the limited duration and frequency of such events and the distance of the Phase 1 WTGs from shore, visible aviation hazard lighting for Phase 1 would result in long-term, intermittent, and **negligible** impacts on recreation and tourism.

Noise: Noise from vessels and offshore construction activities, especially pile driving and trenching, would result in impacts on recreation and tourism. Temporary impacts on recreation and tourism would occur within the SWDA and along the OECC route on species important to recreational fishing and sightseeing. The noise-related temporary disruptions to or changes in offshore fish, shellfish, and marine mammal populations discussed in Sections 3.6 and 3.7 would have a **moderate** impact on recreational fishing, shellfishing, or wildlife-watching activities within the SWDA, although whale-watching tours in particular typically travel north of Cape Cod, away from the SWDA.

In addition to the temporary disruption to fish, shellfish, and marine wildlife populations, noise from offshore construction and onshore cable installation near the landfall area would have impacts on the recreational enjoyment of the marine and coastal environments, with **minor** impacts on recreation and tourism. Covell’s Beach or Craigville Beach and nearby areas would experience noise during construction. Offshore construction noise would occur from vessels, trenching, and pile driving along the OECC and within the SWDA. Pile driving, the noisiest aspect of WTG installation, was projected to generate noise estimated at 60 dBA at a distance of 1 nautical mile (1.15 miles) from the construction zone (Tetra Tech 2012), comparable to the noise level of a normal conversation (OSHA 2011; CDC 2019). Pile driving would occur for approximately 2 to 3 hours per foundation or 4 to 6 hours per day for the installation of two foundations per day. In areas within or near the OECC and SWDA that are available for recreational boating during construction, increased noise from construction would discourage recreational boating. Overall, construction noise from Phase 1 would have localized, short-term, and **minor** to **moderate** impacts on recreation and tourism.

Onshore substation noise would not affect recreational resources. Offshore operational noise from Phase 1 WTGs would be similar to the noise described for offshore wind projects under Alternative A. Accordingly, operational noise from Phase 1 would have a continuous, long-term, and **negligible** impact on recreation and tourism. During decommissioning, noise-related impacts from offshore worksites would be similar to construction (except for the absence of pile driving), with localized, short-term, and **minor** impacts on recreation and tourism from Phase 1.

Port utilization: Several ports within the geographic analysis area for recreation and tourism would be shared by recreational vessel traffic and Phase 1 staging and construction support, including Bridgeport, Vineyard Haven Harbor, and Port of New Bedford. Proposed Project construction is projected to use New Bedford Harbor extensively, with an average of 7 and a peak of 15 vessel round trips daily between New Bedford and offshore construction worksites. Use of Vineyard Haven is uncertain, with an average of six round trips daily anticipated from several ports, including Vineyard Haven, Bridgeport, Davisville, and South Quay Terminal (COP Volume III, Section 7.8.2.1; Epsilon 2022a). Recreational vessel operators are accustomed to existing, high levels of commercial and industrial traffic at the Port of New Bedford (Section 3.13). The added vessel traffic would not significantly affect recreational vessel movements or availability of docking facilities. Construction of Phase 1 would have a short-term and **negligible** to **minor** impact on recreation and tourism due to port utilization within the geographic analysis area.

The applicant anticipates using Bridgeport Harbor as the operations base and Vineyard Haven Harbor for crew transfer and support vessels during Phase 1 operations (COP Volume III, Section 7.8.2.1; Epsilon 2022a). On average, no more than one vessel round trip daily is anticipated, from either of these ports or possibly from other ports for a specific maintenance need. The operational vessel traffic would not significantly affect recreational vessel movements or availability of docking facilities at Vineyard Haven. Accordingly, Phase 1 operations would have long-term, continuous, and **negligible** impacts on recreation and tourism due to port utilization within the geographic analysis area.

Decommissioning may result in short-term, increased use of port facilities that also serve recreational vessel traffic, with short-term and **negligible** to **minor** impacts on recreation and tourism from Phase 1.

Presence of structures: The Phase 1 onshore substation and potential expansion of the West Barnstable Substation would have no impacts on recreational or tourism resources, as these facilities are not adjacent to and unlikely to be visible from recreational lands or facilities. Other onshore facilities (cables and landfall vaults) would be underground, with no impact on aboveground uses except when maintenance or repairs are needed, as addressed in the cable emplacement and maintenance IPF above.

Phase 1 could include up to 63 structures (including up to 62 WTGs and 1 or 2 ESPs). Recreational vessels within the SWDA would need to navigate around and between the foundations of the WTGs and ESPs. The offshore structures would impact recreation and tourism through increased navigational complexity; risk of allision or collision; attraction of recreational vessels to offshore wind structures for fishing and sightseeing; the adjustment of vessel routes used for 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.

AIS transmissions found that 397 recreational vessel tracks were recorded within the SWDA during the 4-year period from 2016 through 2019, representing approximately 20 percent of all AIS vessel tracks within the SWDA during this time period. The vessels ranged in size from 15 to 300 feet, with most in the 45- to 60-foot range (COP Appendix III-I, Section 6.5; Epsilon 2022a). The AIS transmissions do not include smaller vessels not required to carry an AIS transmitter. As discussed in Section 3.15.1, recreational boaters in the northeast region generally report fishing as their most common activity, followed by wildlife viewing and relaxing. HMS fishing trips are especially likely to travel as far offshore as the SWDA. Long-distance sailing races also are known to use the area.

Recreational vessels are expected to continue to transit through the SWDA if Phase 1 is built, and continued recreational fishing is anticipated in the area (COP Appendix III-I, Section 9.2; Epsilon 2022a). Some recreational anglers may avoid the SWDA due to concerns about their ability to safely fish within or navigate through the area. The navigational risks resulting from the offshore wind structures are described in greater detail in Section 3.13. For recreational anglers harvesting HMS such as tuna, sharks, and billfish, the spacing of the WTGs could affect access to fishing locations. The fishing methods used, and the size, strength, and swimming speed of these larger species requires significantly more space for fishing, compared to other species; as a result, the proposed separation between WTGs may be insufficient for this type of fishing. Anglers who fish within the SWDA would need to change their methods (i.e., they would not be able to allow their boats to drift and would need to correct course to avoid WTGs).

Although some recreational anglers would avoid the SWDA, scour protection around the foundations would likely attract forage fish, as well as game fish, which could provide new opportunities for certain recreational anglers. Evidence from Block Island Wind Farm indicates an increase in recreational fishing near the WTGs (Smythe et al. 2018). The fish aggregation and reef effects of Phase 1 could also create foraging opportunities for seals, small odontocetes, and sea turtles, attracting recreational boaters and sightseeing vessels. The magnitude of benefits on recreational fishing and sightseeing from the proposed Project's foundations would be reduced due to the distance from shore (Starbuck and Lipsky 2013).

For-hire fishing operations are part of the recreation and tourism industry and are included in the impacts on recreational boating and fishing anticipated in this section. The detailed discussion of impacts on for-hire fishing activities provided in Section 3.9 may also be applicable to impacts on recreational fishing in general. The impacts on recreational fishing, boating, and sailing in general would be **minor**, while the impacts on for-hire fishing would be **moderate** because these enterprises are more likely to be materially affected by displacement, competition for resources, and longer transit times in a manner similar to commercial fishing businesses. Overall, based on the impacts of the WTGs and ESPs on navigation and fishing (especially HMS fishing), the potential reef effects of these structures, and the risks to anchoring and gear loss associated with scour or cable protection, Phase 1 would have long term, continuous, and **minor** impacts, both adverse and beneficial, on recreation and tourism.

The Phase 1 WTGs would also affect recreation and tourism through visual impacts. Based on the maximum nacelle-top height of 725 feet MLLW, the nacelle-top lights could be visible up to 37.5 miles away (COP Appendix III-H.a, Section 1.2; Epsilon 2022a). Blade tips could be visible at greater distances; this Draft EIS evaluates visual impact up to 46 miles from the WTGs (Section 3.16). Visual impacts of offshore WTGs would be limited to the southern shorelines on Martha’s Vineyard, Nantucket Island, and nearby islands. Mainland Cape Cod is either behind Martha’s Vineyard or beyond the theoretical area of nacelle visibility. The WTGs would be at least 21 miles from the nearest land on Martha’s Vineyard and at least 25 miles from the nearest land on Nantucket. Views of the top of the nacelle are theoretically possible from the western Elizabeth Islands, about 31 miles from the nearest Phase 1 WTG (COP Appendix III-H.a, Section 1.2; Epsilon 2022a). Based on typical atmospheric conditions, WTGs would be visible from Gay Head Lighthouse for approximately 36 percent of annual daylight hours, and from the Nantucket Historic District approximately 27 percent of annual daylight hours (COP Appendix III-H.a, Table 7; Epsilon 2022a).

Recreational facilities in the geographic analysis area with potential views of WTGs include seven beaches along Martha’s Vineyard’s south coast (public or town residents only), four beaches on Nantucket’s south coast, the Gay Head Lighthouse, resorts, walking and biking paths, and natural areas (COP Appendix III-H.a, Section 4.0; Epsilon 2022a). Private residences with ocean views to the south may be used as vacation homes. Views of 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 views of offshore wind structures and resultant impacts on recreation and tourism is summarized in Section 3.15.3. All coastal public viewpoints would be more than 20 miles from the closest Phase 1 WTGs. Moreover, the closest Phase 1 WTGs would be farther away than and only visible behind the WTGs of other offshore wind projects and would, thus, be less distinct. Research described in Section 3.15.2.1 suggests that at a distance of at least 15 miles, only 6 percent of beach visitors would select a different beach based on the presence of future offshore wind turbines.

The impact of visible WTGs on the use and enjoyment of recreation and tourism resources during operations would be long term, continuous, and **negligible**. 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. Coastlines and inland areas with no views of WTGs would not experience visual impacts, and beaches with views of Phase 1 WTGs could also gain trips from beach visitors for whom viewing the WTGs would be a positive result, offsetting some lost trips from visitors who consider views of WTGs to be negative (Parsons and Firestone 2018). None of the Phase 1 WTGs are within 15 miles of shore (Appendix E).

Upon completion of decommissioning, the Phase 1 WTGs would no longer be present, reversing the impacts on recreation and tourism that resulted from the presence of WTGs and ESPs. The impacts of the presence of Phase 1 structures on recreation and tourism during decommissioning would decrease from operations (**minor**) to no impact at the completion of decommissioning. Similarly, the presence of structures from other ongoing and planned activities, including Phase 1, would decrease from operations (**minor** to **moderate**) to no impact at the completion of decommissioning of all other offshore wind projects in the RI/MA Lease Areas.

Traffic: Phase 1 would contribute to increased vessel traffic and associated vessel collision risk along routes between ports and the offshore construction areas. Phase 1 would generate an average of 6 daily vessel trips during the entire construction period, with up to 15 average daily vessel trips during peak periods, passing through the offshore geographic analysis area as the vessels transit between ports and the offshore construction work areas (including the OECC and the SWDA).

The presence of vessels and worksites within the SWDA and along the OECC would affect recreational boaters, boat tours, and charter boats. Construction would take place over a roughly 2-year period, with an average of 30 and a maximum of 60 vessels present at offshore work areas (COP Volume I, Figure 3.1-3, and Volume III, Section 7.8.2.1; Epsilon 2022a). Although boating activity within the SWDA is much lower in volume than in areas closer to the coast, it is traversed by recreational fishing vessels (especially HMS anglers), and other vessels operate within or near the SWDA (Section 3.15.1.2). At least three long-distance races may have routes through the SWDA; these races typically occur every 2 to 4 years and could occur during construction within the SWDA, but a diversion around the SWDA would not add appreciably to travel time (COP Appendix III-I, Section 6.5; Epsilon 2022a).

Where established by the USCG, the applicant would use a flexible, temporary safety zone around active construction areas within 12 nautical miles (13.8 miles) of the coast. The applicant would work with the USCG to communicate these zones and all work areas farther offshore to the boating public via Broadcast Notice to Mariners and other standard communication means (COP Appendix III-I, Section 11.1; Epsilon 2022a). The applicant would develop and implement a marine communications procedure for construction that would include a marine coordinator and coordination center, ongoing communication with the USCG, regular Offshore Wind Mariner Update Bulletins, regular notifications to local port communities and local media, and website updates (COP Appendix III-I, Section 11.2; Epsilon 2022a). With implementation of the safety measures and notifications, recreational boaters in the geographic analysis area would experience minor inconvenience and increased risk due to the need to navigate in proximity to proposed Project-related vessels and avoid work areas, resulting in short-term, variable, and **minor** impacts.

Phase 1 operations would generate modest levels of vessel traffic. For regularly scheduled maintenance and inspections, the applicant anticipates approximately 290 vessel round trips from a port to the SWDA annually for Phase 1, or less than 1 round trip daily. For Phase 1 and 2 combined, the applicant anticipates approximately 590 vessel round trips annually or less than 2 round trips daily. SOVs would stay offshore for several days and up to several weeks at a time. Occasional larger service vessels would be needed that would also stay in the SWDA for several days. Therefore, while less than one daily vessel round trip to the SWDA is anticipated, an average of five are anticipated to be operating within the SWDA daily for Phase 1 and an average of seven vessels for Phases 1 and 2 combined (COP Volume III, Section 7.8.2.2.1; Epsilon 2022a). More vessels may be needed for certain maintenance or repair scenarios, with no more than 15 vessels in the SWDA at any one time for Phases 1 and 2 combined. The portions of this vessel traffic that originate from Bridgeport Harbor, Vineyard Haven Harbor, or the Port of New Bedford would be consistent with the working seaport character of those ports and would not affect ongoing recreational use. Recreational vessels navigating within the SWDA would be able to navigate around Phase 1-related vessels working in the SWDA. Accordingly, traffic resulting from Phase 1 operations would have long-term and **negligible** impacts on onshore recreation and tourism.

Section 2.3, Non-Routine Activities and Low Probability Events, describes the non-routine activities associated with Phase 1. Activities requiring repair of WTGs, equipment or cables, or spills from maintenance or repair vessels would generally require intense, temporary activity to address emergency conditions or spills. In such situations, the unexpectedly frequent vessel activity in Vineyard Haven

Harbor or the Port of New Bedford, and in offshore locations above the OECC or near individual WTGs, could temporarily prevent or deter recreation or tourist activities near the site of a given non-routine event. The impacts of non-routine activities on recreation and tourism would be temporary and **minor**.

Decommissioning would require vessel and equipment usage for removal of offshore structures, with impacts similar to construction. Provided that the applicant works with the USCG to establish safety zones and uses the same standard communication methods as for the construction stage, decommissioning of Phase 1 would have **minor** impacts on recreation and tourism from Phase 1.

Impacts of Phase 2

The impacts of Phase 2 on recreation and tourism would be the same as for Phase 1, except where specifically discussed in this section.

If the applicant includes the SCV as part of the final proposed Project design, impacts associated with the SCV may occur either in place of or in addition to the impacts associated with the Phase 2 OECC through Muskeget Channel. Except where specifically discussed in this section, the impacts of the SCV in federal waters (3 miles or greater from shore) would occur in different locations than the proposed OECC route through Muskeget Channel but would otherwise be the same magnitude as those described for Phase 1. The nearshore portion of the SCV (less than 3 miles from shore) and onshore components of the SCV have not yet been defined. BOEM will provide a more detailed analysis of the impacts of the SCV and the Phase 2 OECC and OECR on recreation and tourism in a supplemental NEPA analysis.

Cable emplacement and maintenance: While the Phase 2 OECR would use different potential routes than Phase 1, the impacts of the Phase 2 OECR would be the same as for Phase 1.

Lighting: During operations, nighttime aviation hazard lighting from Phase 2 WTGs could be visible from south-facing coastlines and elevated locations on Martha’s Vineyard, Nantucket, and neighboring islands, depending on vegetation, topography, and atmospheric conditions (COP Appendix III-H.a, Section 5.2.1; Epsilon 2022a). Phase 2 lighting (which would also employ ADLS) would be more distant from viewers than Phase 1 and would continue to have **negligible** impacts on recreation and tourism. The impacts of Phase 2 lighting in the context of other ongoing and planned activities would remain **minor** but could be reduced to **negligible** if other offshore wind projects also employ ADLS.

Presence of structures: Phase 2 could include up to 89 structures (including up to 88 WTGs and 2 or 3 ESPs), depending on the number of WTGs installed for Phase 1. Although Phase 2 would involve more WTGs, the impacts on recreation and tourism from the presence of these structures would be similar to those described for Phase 1: **minor** impacts on recreational fishing, boating, and sailing; **moderate** impacts on for-hire fishing (especially HMS fishing); **minor** beneficial impacts on for-hire fishing and wildlife viewing; **negligible** impacts due to visual effects; and **minor** impacts in the context of ongoing and planned activities. The impacts of decommissioning would also be the same as Phase 1: decreasing from **minor** to no impact for Phase 2 and decreasing from **minor** to **moderate** to no impact in the context of other ongoing and planned activities.

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-12 in Appendix G would contribute to impacts on recreation and tourism through the primary IPFs of cable maintenance and emplacement, anchoring and gear utilization, noise, and the presence of structures. These impacts would primarily occur through impacts on recreational activities resulting from views of the WTGs and impacts to recreational vessel navigation due to the presence of structures and construction activities. The cumulative impacts of all IPFs from ongoing and planned activities would be **moderate** and **minor** beneficial.

Conclusions

Impacts of Alternative B. The impacts resulting from individual IPFs associated with the proposed Project, including Phases 1 and 2, would range from **negligible** to **moderate** impacts and **negligible** to **minor** beneficial impacts. Key short-term impacts during construction include noise, anchored vessels, and hindrances to navigation from the installation of the OECC and WTGs; key long-term impacts result from the presence of cable hard cover and structures during operations, with resulting impacts on recreational vessel navigation and visual quality. Beneficial impacts would result from the reef affect and sightseeing attraction of offshore wind energy structures.

Considering all the IPFs together, Alternative B would have long-term and **minor** impacts on recreation and tourism in the geographic analysis area due to the constraints on and greater navigational risks for recreational vessels within the SWDA, and the impact of up to 1,013 WTGs visible from coastal locations. It would also have long-term and **minor** beneficial impacts due to the fish aggregation and habitat conversion impacts of the WTGs and ESPs, resulting in new fishing and sightseeing opportunities. Alternative B would have short-term and **minor** impacts during construction due to the temporary impacts of noise and traffic on recreational vessel traffic, the natural environment, and species important for recreational fishing and sightseeing.

Cumulative Impacts of Alternative B. The cumulative impacts on recreation and tourism in the geographic analysis area from Alternative B combined with ongoing and planned activities would be **moderate** adverse and **minor** beneficial. The impact ratings include the long-term and **minor** to **moderate** adverse impacts and **minor** beneficial impacts associated with the presence of offshore structures and cable hard cover. The overall **moderate** impacts are also indicated by the short-term and **minor** to **moderate** impacts during construction from anchoring and gear utilization, cable emplacement and maintenance, noise, and traffic. **Moderate** impacts include both impacts on marine recreational activities and impacts on recreation and tourism in portions of the geographic analysis area resulting from the visual impact of WTGs. The **minor** beneficial impacts would result from a small but measurable benefit from the opportunities provided by future offshore wind structures for tours and recreational fishing.

3.15.2.4 Impacts of Alternative C – Habitat Impact Minimization Alternative on Recreation and Tourism

Alternatives C-1 and C-2 would not affect the number or placement of WTGs or ESPs for the proposed Project compared to Alternative B. While Alternatives C-1 and C-2 would alter the exact routes of export cables and exclude the Western Muskeget Variant—and could, thus, affect the exact length of cable installed and area of ocean floor disturbed—these changes would not result in meaningfully different impacts on recreation and tourism compared to Alternative B. Therefore, the impacts of Alternatives C-1 and C-2 on recreation and tourism would be the same as those of Alternative B.

3.16 Scenic and Visual Resources

This section discusses the affected environment and potential impacts on seascape, open ocean, landscape character, and viewers from the proposed Project, alternatives, and ongoing and planned activities in the scenic and visual resources geographic analysis area using methodology recommended by Sullivan (2021) and the Landscape Institute and Institute of Environmental Management and Assessment (LI and IEMA 2013). The geographic analysis area for scenic and visual resources is described in Table D-1 in Appendix D, Geographical Analysis Areas, and is shown on Figure 3.16-1. Specifically, the geographic analysis area is the maximum theoretical area of WTG nacelle[33] visibility for offshore components and the maximum theoretical area of visibility of onshore aboveground equipment, including substations and related improvements. The applicant states that the tops of the proposed Project's WTG nacelles at 725 feet MLLW (where FAA-required aviation hazard lighting would be mounted) could be visible within a 37.5-mile radius from all proposed Project WTG positions (COP Appendix III-H.a; Epsilon 2022a). The onshore geographic analysis area includes the area within view of the proposed substations, based on existing vegetation, topography, and the presence of structures not related to the proposed Project that could limit views of the proposed Project's onshore facilities. The onshore geographic analysis area does not include the OECR and OECC landfall sites because those components would be installed underground. The geographic analysis area encompasses the following locations:

- Martha's Vineyard, Nantucket, and adjacent islands;
- A portion of the Massachusetts mainland near Falmouth, as well as the Elizabeth Islands southwest of Falmouth; and
- Onshore locations adjacent to the West Barnstable Substation site in the Towns of Barnstable and West Barnstable, Massachusetts.

BOEM's methodology for evaluating the visible impacts of offshore wind projects combines two concepts (Sullivan 2021):

- **Seascape and Landscape Impact Assessment (SLIA):** "SLIA analyzes and evaluates impacts on both the physical elements and features that make up a landscape or seascape and the aesthetic, perceptual, and experiential aspects of the landscape or seascape that make it distinctive. These impacts affect the 'feel,' 'character,' or 'sense of place' of an area of landscape or seascape, rather than the composition of a view from a particular place. In SLIA, the impact receptors (the entities that are potentially affected by the proposed project) are the seascape and landscape itself and its components, both its physical features and its distinctive character."
- **Visual Impact Assessment (VIA):** VIA "analyzes and evaluates the impacts on people of adding the proposed development to views from selected viewpoints. VIA evaluates the change to the composition of the view itself and assesses how the people who are likely to be at that viewpoint may be affected by the change to the view. Enjoyment of a particular view is dependent on the viewer, and in VIA, the impact receptors are people."

The BOEM methodology is consistent with methodology for evaluating impacts from proposed offshore wind projects in the United Kingdom and independent studies (LI and IEMA 2013; Scottish National Heritage 2012; Sullivan et al. 2012) to qualitatively assess potential seascape/landscape impacts, as well as potential visual impacts. Appendix I, Seascape, Landscape, and Visual Impact Assessment (SLVIA),

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[33] The nacelle refers to the housing located at the top of the WTG column, where the hub and blades are attached.

contains a more detailed analysis of the SLIA and VIA for the proposed Project, and provides the applicant's visual simulations of the proposed Project and other offshore wind projects.

3.16.1 Description of the Affected Environment

3.16.1.1 Geographic Scope

BOEM's SLVIA methodology evaluates impacts within a zone of theoretical visibility, defined as "the viewshed that results from ignoring all screening elements except topography" (Sullivan 2021). The applicant's analysis instead uses a zone of visual influence (ZVI), which identifies portions of the offshore geographic analysis area within which there is a probability that all or a portion of the nacelles for the proposed Project's WTGs would be visible above the horizon from land-based vantage points. The applicant defined the ZVI, as shown on maps in the COP (Appendix III-H.a; Epsilon 2022a), through geographic information system viewshed calculations, assuming clear atmospheric conditions, an observer height of 6 feet above ground level, and a coefficient of refraction (i.e., a measure of how the earth's atmosphere bends or curves light, thus affecting the distance at which objects are visible) of -0.088 (COP Appendix III-H.a; Epsilon 2022a). While the zone of theoretical visibility and ZVI are not identical, they reflect comparable concepts, and the ZVI helps to frame the geographic extent of views of proposed Project components, particularly WTGs.

The blades of the proposed Project WTGs, which would extend up to 1,171 feet MLLW, would be visible from substantially farther away than the nacelles. For this assessment, 40 nautical miles (46 miles) was set as the limit for assessment of impacts. Studies of onshore and offshore visibility for smaller WTGs—onshore WTGs with maximum blade tip heights of up to 383 feet above ground (Sullivan et al. 2012) and offshore WTGs with maximum blade tip heights of 449 feet above the surface (Sullivan et al. 2013)—suggest that the extinction point for views of these shorter WTGs and other structures is much less than 40 nautical miles (46 miles). Based on these studies and BOEM's SLVIA methodology (Sullivan 2021), this EIS uses 40 nautical miles (46 miles) as an outer limit for visibility.

The applicant did not prepare a ZVI or other viewshed for onshore underground facilities because the OECR and grid interconnection cables would be installed within roads and utility ROWs and would not be visible. The applicant also did not prepare a ZVI for the Phase 1 onshore substation, although the COP (Appendix III-H.a; Epsilon 2022a) includes simulations of the substation with and without potential future vegetative screening added by the applicant. The location of the Phase 2 onshore substation (if the Phase 1 substation location cannot be used for Phase 2) has not been identified (COP Appendix III-H.a; Epsilon 2022a).

3.16.1.2 Existing Seascape, Open Ocean, and Landscape Character (Seascape and Landscape Impact Assessment Baseline)

Martha's Vineyard and Nantucket were formed by the last period of continental glaciation and the rise in sea level that followed. This created islands that are generally characterized by low elevations, with undulating hills and shallow depressions. Elevations range from sea level to an average of approximately 110 feet AMSL, with specific locations rising above 200 feet AMSL. Most of the oceanfront on these islands is fringed by barrier beaches and sand dunes. The western and northwestern parts of Martha's Vineyard are marked by ridges and hills that extend southwesterly and end at the high cliffs of Aquinnah (Gay Head), Nashaquitsa, and Squibnocket. The elevation of these hills averages approximately 200 feet AMSL but extends as high as 300 feet in some areas (COP Appendix III-H.a; Epsilon 2022a).

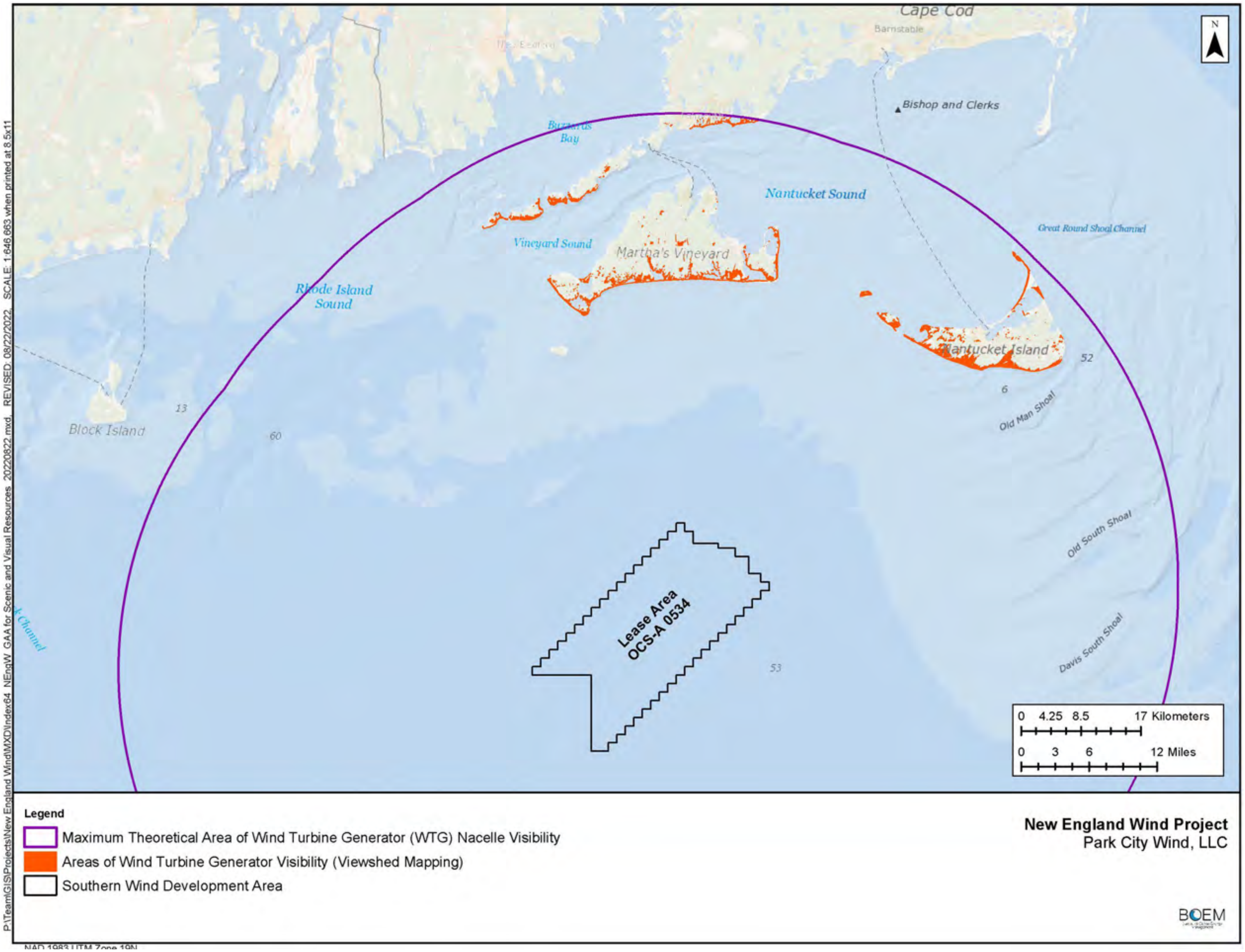

Figure 3.16-1: Geographic Analysis Area for Seascape, Landscape, and Visual Resources

The overall aesthetic character of Martha's Vineyard and Nantucket can generally be described as small-town landscapes with minimal urban development. Vegetation is characterized by a mix of scrub forest, upland heaths, sand plain grasslands, salt marshes, and open fields (agricultural and successional). Developed features include village centers, year-round and vacation homes, roads, and harbors/ports.

The horizon looking south toward the SWDA from the various coasts is typically defined by a view of the open ocean. Development and infrastructure at some of the viewpoints includes artificial lighting, which results in some light pollution; however, most daytime and nighttime views are typical of beaches and natural areas with little development. Lights from vessels can be seen from all coastal locations along the ocean horizon on most nights except in foggy conditions (COP Appendix III-H.a; Epsilon 2022a).

The applicant classified the geographic analysis area according to landscape units, defined as "areas with common characteristics of landform, water resources, vegetation, land use, and land use intensity…a landscape unit is a relatively homogenous, unified landscape (or seascape) of visual character. Landscape units are established to provide a framework for comparing and prioritizing the differing visual quality and sensitivity of visual resources" (COP Section 2.1, Appendix III-H.a; Epsilon 2022a).[34] Table 3.16-1 defines the landscape units (which also include ocean and shoreline areas).

Impacts on a particular seascape or landscape unit are a function of that unit's sensitivity to change, along with the magnitude of impacts. The sensitivity to change is a product of each unit's susceptibility to change and value. Susceptibility is the unit's "ability to accommodate the impacts of the proposed project without substantial change to the basic existing characteristics of the seascape/landscape" (Sullivan 2021). Value is assigned by society overall; higher values are associated with scenery that user groups feel to be distinctive, aesthetically appealing, or tranquil, or where the seascape or landscape contain important cultural or natural resources or characteristics (Sullivan 2021). Impact magnitude is a function of the size or scale of visible change, the geographic extent of the change, and the durability and reversibility of the change (Sullivan 2021).

Proposed Project visibility factors—the "variables affecting the actual visibility of an object in the landscape" or seascape (Sullivan 2021) can vary from day to day and throughout a single day. These factors include viewer characteristics, viewshed limiting factors (e.g., topographic and vegetative screening), lighting (e.g., weather and sun position), atmospheric conditions, viewing angles, the viewing backdrop, and the visual characteristics of the objects being viewed (e.g., size, scale, color, form, line, texture, and motion) (Sullivan 2021). BOEM conducted a meteorological study in 2017 to assess typical visibility conditions near the RI/MA Lease Areas at varying distances (BOEM 2017b). Table 3.16-2 summarizes these data at the Nantucket and Martha's Vineyard airports.

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[34] The applicant's methodology for describing the affected environment differs from the methodology in Sullivan (2021); however, BOEM determined that the information provided by the applicant was sufficient to support analysis of seascape, landscape, and visual impacts for the proposed Project.

Table 3.16-1: Seascape, Open Ocean, and Landscape Units within the Geographic Analysis Area

Seascape Units	**Description**
Ocean Beach Unit	Miles of sand beaches are a defining aesthetic feature of Martha's Vineyard, Nantucket, and Cape Cod. Beaches are a significant attraction for sunbathers, surfers, fishermen, and beachcombers. During the summer season, certain stretches of the beach setting are at capacity. At other times of the year, beaches can be nearly deserted and appear in a seemingly pristine natural condition. As a daytime destination, visitors bring brightly colored umbrellas, coolers, folding chairs, towels, and recreational watercraft. Southerly views from the beach encompass views of the open water landscape across the Open Water/Ocean Unit. The beaches are both sandy (primarily on Nantucket, along the south coast of Cape Cod, the perimeters of the Elizabeth Islands, and the eastern portion of Martha's Vineyard) and rocky (primarily on the western portion of Martha's Vineyard). Breaking surf is a continuous and unique visual condition. Viewer activity is primarily recreational in nature including passive sunbathing, swimming, walking/beach combing, surf fishing, and surfing. Beaches are also used by recreational and commercial fishermen. Views are almost always unobstructed and considered highly scenic. Views extend up and down the coast and across open water as one looks out to sea. Inland views include grassy dunes and coastal scrub vegetation. Man-made structures are frequently visible from beach locations, although extended stretches of beachfront on Martha's Vineyard and Nantucket are located within protected open space areas with little to no man-made development within immediate view.
Coastal Bluff Unit	Portions of the coastal area are defined by a distinctive topographic rise in elevation from the beach below, with coastal scrub vegetation at the top of the bluffs. Dramatic coastal bluffs occur at the eastern end of Martha's Vineyard at Gay Head, Aquinnah, and Chilmark where the land rises steeply from sand or rocky beaches to elevation of 30 meters (100 feet) or more. Notable bluffs in this area include Gay Head Cliffs, Zacks Cliffs, Squibnocket Ridge, Nashaquitsa Cliffs, and Wequobsque Cliffs. Less dramatic bluffs are found at Wasque Point at the southern end of Chappaquiddick Island where topography steeply rises 15-30 meters (50-100 feet) above beach elevation. The Coastal Bluffs Unit is defined by scenic open vistas of the ocean and distant landscape from an elevated vantage point. Viewers frequently visit these areas specifically to enjoy scenic vistas over the ocean and long distance views up and down the coastline. Bluff vistas also commonly include man-made development including roads and vehicles, overhead utility lines, and residential development.
Open Ocean Unit	
Open Ocean Unit	The open water/ocean unit includes the open water of the Atlantic Ocean, Nantucket Sound, Vineyard Sound, Buzzards Bay, and Rhode Island Sound more than 3 nautical miles (3.5 miles) from shore. This unit is characterized by broad expanses of open water that forms the dominant foreground element in all directions. From all vantage points, the Project will be viewed over open water. In general, the waters of the Atlantic Ocean appear dark bluish-gray typical of northeastern U.S. oceanic water (as compared to the light greenish blue colors common to southeastern waters of the U.S.). Cloud cover, wind, sun reflectance, and surface glare affect the color of the water and often create patterns of color variation over the water surface. The visible texture of the water is affected by the action of waves, which can include flat water, rolling swells, and/or choppy white cap conditions. These factors contribute to an amalgam of shimmering colors and patterns of light that are of aesthetic interest and may command the attention of observers. The waters off Cape Cod, Martha's Vineyard, and Nantucket support a wide variety of human activities including water sports, recreational boating (sail and power craft), recreational and commercial fishing, ferry services, and commercial shipping, among others uses. Navigation through the area includes ocean going vessels headed to or from major ports (e.g., New York and Boston), commercial fishing vessels, ferry transport (Nantucket and Martha's Vineyard ferries), pleasure craft, and sport fishing boats. The ocean, sound, channels, harbors, and bays are marked with maritime aids (e.g., buoys, channel markers, warning lights).

Seascape Units	**Description**
Landscape Units	
Coastal Dunes Unit	The inland edge of the Ocean Beach Unit is defined by undulating sand dunes typically ranging in height from 3-6 meters (10-20 feet). Dunes are typically vegetated with low grasses and low shrubs. Coastal dunes typically occur along the shoreline between the ocean beaches and more inland landforms and are present throughout the study area on Cape Cod, especially in the easterly limit of the proposed APE, as well as on Martha's Vineyard and Nantucket. The dunes are typically traversed by narrow enclosed footpaths through the beach grass that provide public access to the beaches from inland roads and parking areas. Ocean views from the back side of the Coastal Dune Unit are largely restricted by the dune terrain. Viewer activity is almost exclusively recreational, focused on walking/sight-seeing and beach access from inland roads and parking areas.
Salt Pond/Tidal Marsh Unit	Salt ponds and tidal marshes inland of the Ocean Beach Unit are common throughout the coastal area. Disconnected from the ocean except during flooding events, or connected to the ocean by narrow tidal channels, these water features are defined by shallow open water and buffered by herbaceous grasses and other salt tolerant vegetation. In those with hydraulic connections to the ocean, water levels rise and fall with the tide, exposing mud flats. Views over the water body and flat marshland extend until interrupted by adjacent dunes and/or scrub vegetation. Residences often are present along the edges of the ponds, many with associated docks and boats. Recreational activities in this unit include walking, boating, clam digging, and bird watching.
Coastal Scrub Brush Unit	At varying distances inland from the Coastal Beach, Coastal Dunes, and Salt Pond/Tidal Marsh Units, the coastal landscape transitions into a more heavily vegetated scrub brush and low forest condition. The Coastal Scrub Brush Unit (and the Forest Unit described below) is characterized by low dense woody and herbaceous vegetation—the dominant forest is Pitch Pine-Oak forest, which occurs on Cape Cod, Martha's Vineyard, and Nantucket. Scrub vegetation is commonly found on upland dunes and plains above tidal conditions. Landform is often comprised of small hills and eroded hollows. Vegetation is often thick and nearly impenetrable, and views are frequently obstructed by dense foliage. Distant vistas may be limited to view corridors along roadways or where scrub brush transitions to open meadow. Viewer activity is typically limited to local travel and recreational use, such as walking and biking.
Forest Unit	Inland from various coastal units are extended wooded areas including both deciduous and coniferous species (e.g., oaks, hickories, and white pine). The understory is comprised of mixed shrubs, vines, and saplings. In areas exposed to coastal winds, trees are often irregular in form and stunted; trees located in better shielded inland areas are taller and more regular in form. Although this landscape type once dominated the interior of Martha's Vineyard, Nantucket, and Cape Cod, various forms of human development extensively encroach upon this area, and only a patchwork of mature forest remains. A variety of land use activities exist in the Forest Unit, including residential development, roads, small open yards and fields, and other land uses. Such conditions are not specifically identified as separate units due to the visual dominance of the surrounding forest. Topography in the Forest Unit is typically level to rolling with distinct ridges and gullies. Views are frequently restricted to openings in the forest canopy and axial views along roadways. Viewer activity includes residential uses and local travel. Recreational uses include walking and bicycling through the woods along local roads and trails.
Shoreline Residential Unit	Shoreline (or near shoreline) residential development is common in coastal areas not currently protected by public and private land conservation initiatives. Residential development ranges from small bungalow-style beach houses to large well-maintained vacation homes. The developments are a mix of densely developed areas, such as Falmouth Heights and Popponnesett (Mashpee) and Nantucket harbor, and low-density developments on the south shores of Martha's Vineyard and Nantucket. Although sometimes screened by coastal scrub vegetation, shoreline residences typically have panoramic views of the ocean, salt ponds/tidal marshes, and/or dune landscape. Architecture is a mixture of old and new construction and traditional/historic and contemporary styles. The local landscape is gently rolling with a mix of coastal scrub, heath, and dunes surrounding maintained residential landscapes. Larger trees are generally not present in beachfront locations. Shoreline residential homes are often used seasonally by owners or offered as vacation rentals. Visitors to these properties enjoy views of the ocean or beachfront landscape and frequently walk or drive from the residential property to the beach and other scenic coastal locations as part of their vacation routine.

Seascape Units	Description
Village/Town Center Unit	The Village/Town Center Unit includes clearly identifiable population centers including Vineyard Haven, Oak Bluffs, and Edgartown on Martha's Vineyard; Woods Hole and West Falmouth on Cape Cod; and Nantucket Village on Nantucket. This zone is comprised of moderate to high density residential and commercial development in a village setting. Vegetation most commonly includes street trees and residential landscaping yard trees. Buildings (typically two to three stories tall) and other man-made features dominate the landscape. Architecture is highly variable in size, style, and arrangement. Each town center on Martha's Vineyard and Nantucket maintains an individual and distinctive New England character. Village/Town Centers are widely recognized as quaint small town destinations and highly scenic places. On Martha's Vineyard and Nantucket, village and town centers are small coastal seaports with clusters of historic buildings focused around clearly defined and thriving downtown commercial districts. Side streets are characterized by well-maintained residential structures adjacent to the village center. Buildings are most commonly of a traditional New England architectural style and arranged in an organized pattern focusing views along the streets. Buildings, street trees, and local landscaping enclose and prevent long distance views.
Rural Residential Unit	The Rural Residential Unit is found along the frontage of rural roads through Cape Cod, Martha's Vineyard, and Nantucket, outside of the Village/Town Center Unit and the Suburban Residential Unit and inland from coastal areas. Structures are typically single family homes that vary widely in age and architectural style, from the traditional Cape style house to modern modular homes and historic farm houses. Residences tend to be larger and well maintained, often with a traditional New England character. Rural residences on Cape Cod vary in size from small Cape or ranch style homes to larger farm houses, and are generally located on paved roads. On Martha's Vineyard and Nantucket, the older homes vary in size, while newer seasonal homes are larger estates and located on large lots. Many rural roads on the islands are unpaved. Residential structures are often set back from the road and interspersed with hedgerows and small woodlots. Topography is characterized by relatively level to gently rolling landform typical of inland on Martha's Vineyard and Nantucket. Extended distance views are often restricted to open fields and axial views along residential uses are not typically oriented toward ocean views. Viewer activity includes common residential uses, recreation, and local travel.
Suburban residential unit	Suburban residential development includes medium- to high density single family residential neighborhoods that typically occur on the outskirts of villages and town centers, along secondary roads and cul-de-sacs. The Suburban Residential Unit is most commonly located on Cape Cod and around the perimeter of Village/Town Center Units on Martha's Vineyard and Nantucket. Buildings are most often one- and two-story wood framed structures with peaked roofs and clapboard or shingle siding. House styles are primarily capes, ranches, bungalows, salt boxes, and colonial residential structures. Suburban Residential Units are also found in coastal areas in relatively new clusters of homes designed for year-round, seasonal, or vacation use in areas proximate to beaches and other scenic and recreational resources. Suburban residential developments generally have regularly spaced homes surrounded by landscaped yards. Residential subdivisions are commonly located within forest areas or have pockets of remnant forest vegetation within developed areas. Streets are well-organized in layout, and are often curvilinear in form with well-defined access to collector streets. Activities include normal residential uses and local travel. Views are often limited by surrounding vegetation or adjacent structures. Suburban Residential Units are not typically oriented toward ocean views.
Agricultural/ Open Field Unit	Agricultural land uses within the APE are limited to several small, generally level to gently sloping pastures and crop fields. Livestock and working farm equipment add to the visual interest of the open fields. This unit occurs primarily in inland portions of the APE as a minor component of the landscape on both Martha's Vineyard and Nantucket. Many of the agricultural landscapes are protected open space, either by public agencies, private land trusts, or non-profit organizations. Agricultural lands may offer long distance views. Adjacent forest, coastal scrub, and structures commonly frame/enclose views and provide significant screening. Because this unit largely inland, views to the ocean are relatively rare, with the exception of Bartlett's Farm on Nantucket and the Allen Farm on Martha's Vineyard.

Source: COP Appendix III-H.a; Epsilon 2022a

APE = area of potential effects; COP = Construction and Operations Plan

Table 3.16-2: Visibility Conditions at the Nantucket and Martha's Vineyard Airports, 2017

Measure of Visibility	Martha's Vineyard Airport	Nantucket Airport
Average visibility distance in clear conditions	20 nautical miles (23 miles)	17 nautical miles (20 miles)
Number of days when visibility extends to 20 nautical miles (23 miles) for 50% or more of daylight hours	113 days/year	80 days/year
Days when visibility extends to 30 nautical miles (34.5 miles) for 50% or more of daylight hours	32 days/year	14 days/year

Source: BOEM 2017b

As shown in Table 3.16-2, average visibility is slightly lower at Nantucket as conditions allowing for visibility to 20 nautical miles (23 miles) are generally limited. The frequency of visibility conditions beyond 30 nautical miles (34.5 nautical miles) was not reported but is anticipated to be very rare.

View distances of the proposed Project from onshore locations in the geographic analysis area range from approximately 21.3 miles (at Squibnocket Point on the southwestern tip of Martha's Vineyard) to the 46-mile limit of theoretical visibility described in Section 3.16.1.1 (i.e., along the coast of mainland Cape Cod). At the 21.3-mile distance, the proposed Project would occupy 39 degrees (32 percent) of the typical human's 124-degree horizontal field of view. WTGs from other offshore wind projects in the RI/MA Lease Areas could be as close as 12.3 miles from Squibnocket Point and would occupy the entire 124-degree horizontal view. View angles, percentage of view, and other factors vary considerably from observation locations in the geographic analysis area, as discussed in Appendix I.

The visibility characteristics of WTGs similar in size to those included in the proposed Project and other offshore wind projects can be grouped by distance as follows:

- 0 to 5 miles from the observer: unavoidably dominant features in the view;
- 5 to 12 miles from the observer: strongly pervasive features between;
- 12 to 28 miles from the observer: clearly visible features;
- 28 to 31 miles from the observer: low on the horizon, but persistent features; and
- 31 to 40 miles: intermittently noticed features.

At distances of 12 miles or less, the form of the WTG may be the dominant visual element creating the visual contrast regardless of color. At greater distances, color may become the dominant visual element creating visual contrast under certain visual conditions that give visual definition to the WTG's form and line.

Table 3.16-3 summarizes the definitions of susceptibility levels for seascape, open ocean, and landscape units in the geographic analysis area. Table 3.16-4 summarizes the definitions of value levels for these units. Table 3.16-5 provides definitions of sensitivity and lists the types of locations in the geographic analysis area that meet these criteria.

Table 3.16-3: Seascape, Open Ocean, and Landscape Susceptibility

Setting	Definition
High Susceptibility	Seascape, open ocean, or landscape character are highly vulnerable to the type of change proposed and are distinctive and highly valued by residents and visitors.
Medium Susceptibility	Seascape, open ocean, or landscape character is reasonably resilient to the type of change proposed, moderately distinctive, and moderately valued by residents and visitors.
Low Susceptibility	Seascape, open ocean, or landscape character is unlikely to be affected by the type of change proposed and is common and unimportant to residents and visitors.

Table 3.16-4: Seascape, Open Ocean, and Landscape Value

Setting	Definition
High value	These are areas where character is judged to be distinctive and where scenic quality, wildness, tranquility, and natural or cultural heritage features make a particular contribution to the seascape or landscape. This can include special federal, state, or local designations (e.g., national parks or scenic overlooks) or areas where the seascape, open ocean, or landscape are valued for tourism, cultural or historic context, or other purposes. Most seascape units and the open ocean unit have high value, as do landscape units dominated by natural features, such as the Coastal Dunes, Salt Pond/Tidal Marsh, and Forest units.
Medium value	These are areas where scenic quality, and natural or cultural heritage features contribute to the seascape or landscape but where functional factors such as commerce or transportation also contribute to overall character. Landscape units with a mix of developed and natural-appearing conditions have medium value, including the Coastal Scrub Brush, Shoreline Residential, and Village/Town Center units.
Low value	These are areas where functional factors such as commerce or transportation are the dominant elements of landscape character and where characteristics such as solitude, tranquility and wildness are not expected or sought. Landscape units dominated by development, such as Rural Residential, Suburban Residential, and Agricultural units, have low value.

Source: Sullivan 2021

Table 3.16-5: Seascape, Open Ocean, and Landscape Sensitivity

Setting	Definition	Locations in the Geographic Analysis Area
High Sensitivity Seascape[a]	Seascape character is distinctive and highly valued by residents and visitors.	• Ocean shoreline, beach, and dune areas, and ocean areas • Moshup's Bridge and Vineyard Sound TCP, Nantucket Sound TCP • Native American lands: Chappaquiddick Island TCP, Wampanoag Tribe of Gay Head (Aquinnah) Tribal Lands, Wasque Reservation • Public walking and biking paths along the southern coasts of Martha's Vineyard and Nantucket • Federal, state, or locally designated lands with scenic and/or recreational values: Gay Head Lighthouse, Miacomet Heath WMA, Miacomet Moors WMA, Norton Point Beach, Smooth Hummocks Coastal Preserve, South Beach State Park, South Cape Beach State Park, Tom Nevers Field, Washburn Island State Park and Recreation Area, Wasque Point WMA • Other public, private, and residential beaches on southern shorelines of Martha's Vineyard, Nantucket, and mainland Cape Cod
High Sensitivity Open Ocean	Open ocean characteristics are pristine, highly distinctive, and highly valued by residents and visitors.	This includes ocean areas within the geographic analysis area.
High Sensitivity Landscape[b]	Landscape characteristics are highly distinctive, highly valued by residents and visitors, or within a designated scenic or historic landscape.	This includes scenic coastal areas, bays, islands, sounds, and adjoining estuaries with medium to high resident and visitor use volume. It also includes cemeteries, churches, historic sites, lighthouses, scenic overlooks, schools, town halls, and residential areas within the geographic analysis area.
Medium Sensitivity Seascape,[a] Open Ocean, and Landscape[a]	Seascape, open ocean, and landscape character is moderately distinctive and moderately valued by residents and visitors.	This includes moderately distinctive areas of medium scenic value and low resident or visitor use volume inland areas.
Low Sensitivity Seascape[a] Open Ocean, and Landscape[b]	Seascape, open ocean, and landscape character is common and unimportant to residents and visitors.	This includes indistinctive areas with low scenic value and limited to no resident or visitor use.

[a] Locations also listed under Seascape extend to both Landscape and Seascape.
[b] Locations also listed under Landscape extend to both Seascape and Landscape.
TCP = traditional cultural property; WMA = Wildlife Management Area

3.16.1.3 Existing Visual Experience (Visual Impact Assessment Baseline)

Impacts on the experience of viewers who may observe the proposed Project are a function of the sensitivity of viewers and the magnitude of the visual impacts. Viewer sensitivity reflects the susceptibility of viewers to change along with the value that those viewers place on individual views being evaluated. Table 3.16-6 describes the sensitivity levels and criteria used to assess visual impacts.

Table 3.16-6: View Receptor Sensitivity Ranking Criteria

Sensitivity	Ranking Criteria
High	This includes residents with views of the proposed Project from their homes; people with a strong cultural, historic, religious, or spiritual connection to landscape or seascape views; people engaged in outdoor recreation whose attention or interest is focused on the seascape and landscape and on particular views; visitors to historic or culturally important sites where views of the surroundings are an important contributor to the experience; people who regard the visual environment as an important asset to their community, churches, schools, cemeteries, public buildings, and parks; and people traveling on scenic highways and roads, or walking on beaches and trails, specifically for enjoyment of views.
Medium	This includes people engaged in outdoor recreation whose attention or interest is unlikely to be focused on the landscape and on particular views because of the type of activity; people at their places of livelihood, commerce, and personal needs (inside or outside) whose attention is generally focused on that engagement, not on scenery, and where the seascape and landscape setting is not important to the quality of their activity; and, generally, those commuters and other travelers traversing routes that are dominated by non-scenic developments.
Low	This includes people who regard the visual environment as an unvalued asset.

The applicant identified 21 key observation points (KOP) on Martha’s Vineyard and Nantucket to evaluate the potential visual and scenic impacts of the proposed Project (KOPs 1 to 21 in Table 3.16-7). The KOPs for the proposed Project, which included many of the KOPs identified for and evaluated as part of the Final EIS for Vineyard Wind 1 (BOEM 2021), were selected to be representative of important individual resources and the diverse views of the proposed Project available from Martha’s Vineyard and Nantucket. The KOPs were identified to avoid (to the degree possible) duplication of similar views, seascape or landscape units, and distances to the nearest WTG (John McCarty, Pers. Comm., May 18, 2022). In addition to the 21 KOPs identified by the applicant, KOP 22 represents a theoretical observer on a vessel offshore (not at any specific location) between the southern coasts of Martha’s Vineyard or Nantucket and the SWDA. KOPs 23 through 25 were not listed in the COP (Appendix III-H.a; Epsilon 2022a) as KOPs but provide potential views of the Phase 1 onshore substation and are thus included as KOPs in this analysis.

Table 3.16-7 lists the KOPs; seascape, open ocean, and landscape units; representative resource types; the type of simulation prepared by the applicant; and viewer sensitivity. Based on discussions with BOEM, the applicant prepared full panoramic simulations (124 × 55-degree field of view) from six KOPs, and single-frame photographic simulations from three additional KOPs (COP Appendix III-H.a; Epsilon 2022a).

Offshore viewing receptors include the recreational, fishing, and other vessels (Section 3.13, Navigation and Vessel Traffic). Daytime and nighttime aircraft receptors include travelers arriving and departing at Martha’s Vineyard Airport and Nantucket Memorial Airport and on limited other transiting flights (Section 3.14, Other Uses [National Security and Military Use, Aviation and Air Traffic, Offshore Cables and Pipelines, Radar Systems, Scientific Research and Surveys, and Marine Minerals]). Aircraft receptors are more frequently affected by view-limiting atmospheric conditions than are land and water receptors because aircraft operate within or above cloud cover.

Table 3.16-7: Key Observation Points

KOP	Seascape, Open Ocean, and Landscape Units	Resource Types	Simulation Type	Viewer Sensitivity Rating
1. Aquinnah Cultural Center	Coastal Bluffs	NNL, NRHP	Panoramic	High
2. Long Point Beach	Ocean Beach, Coastal Dunes, Salt Pond/Tidal Marsh	Wildlife Refuge, Recreation, Historic Resources	Single Frame	High
3. South Beach	Ocean Beach, Coastal Dunes	Recreation	Panoramic	High
4. Wasque Reservation	Ocean Bluffs, Coastal Bluffs, Forest	Recreation, Open Space, Conservation	Panoramic	High
5. Madaket Beach	Ocean Beach, Coastal Dunes, Shoreline Residential	Recreation, Historic Resources	Panoramic	High
6. Miacomet Beach and Pond	Ocean Beach, Coastal Dunes, Salt Pond/Tidal Marsh	Recreation, Historic Resources	Single Frame	High
7. Bartlett’s Farm	Agriculture/Open Field	Historic Resources	Single Frame	High
8. Tom Nevers Field	Coastal Bluffs, Coastal Scrub, Maintained Recreation	Recreation	Panoramic	High
9. Gay Head Cliffs Overlook	Coastal Bluffs	NNL, NRHP	None	High
10. Gay Head Lighthouse	Coastal Bluffs	NNL, NRHP	None	High
11. Squibnocket Beach	Ocean Beach	Recreation, Historic Resources	None	High
12. Lucy Vincent Beach	Ocean Beach, Coastal Dunes	Recreation, Historic Resources	None	High
13. Barn House/Skiff-Mayhew-Vincent House	Agriculture/Open Field	NRHP	None	High
14. Chappy Point, Gardner Beach	Village/Town Center	Recreation, Historic Resources	None	High
15. Cisco Beach	Ocean Beach, Coastal Dunes, Salt Pond/Tidal Marsh	Recreation	None	High
16. Surfside Beach	Ocean Beach, Coastal Dunes	Recreation, Historic Resources	None	High
17. Nobadeer Beach Pond Road	Ocean Beach, Coastal Dunes	Recreation, Historic Resources	None	High
18. Green Point Lighthouse	Ocean Beach, Coastal Dunes	NRHP, Recreation	None	High
19. Rock Landing	Ocean Beach, Coastal Bluff	NRHP, Recreation	None	High
20. Dowse’s Beach	Ocean Beach, Coastal Dunes	NRHP, Recreation	None	High
21. Peaked Hill Reservation	Coastal Scrub Brush, Forested	Recreation	Panoramic	High
22. Representative Offshore View	Open Ocean	Recreation	None	High
23. Shootflying Hill Road (Existing Hotel)	Village/Town Center	Commercial	Single Frame	Low
24. Shootflying Hill Road (ROW #343)	Coastal Scrub Brush, Forested	Utility Infrastructure	Single Frame	Low
25. Exit 6 Park and Ride/ Highway Rest Area	Village/Town Center	Commercial	Single Frame	Low

Source: COP Tables 8 and 9, Appendix III-H.a; Epsilon 2022a

KOP = key observation point; NNL = National Natural Landmark; NRHP = National Register of Historic Places; ROW = right-of-way

3.16.2 Environmental Consequences

Definitions of impact levels for scenic and visual resources are described in Table 3.16-8. There are no beneficial impacts on scenic and visual resources.

Table 3.16-8: Impact Level Definitions for Scenic and Visual Resources

Impact Level	Impact Type	Definition
Negligible	Adverse	SLIA: There is very little or no impact on seascape/landscape unit character, features, elements, or key qualities either because unit lacks distinctive character, features, elements, or key qualities; values for these are low; or Project visibility would be minimal. VIA: There is very little or no impact on viewers' visual experience because view value is low, viewers are relatively insensitive to view changes, or Project visibility would be minimal.
Minor	Adverse	SLIA: The Project would introduce features that may have low to medium levels of visual prominence within the geographic area of an ocean/seascape/ landscape character unit. The Project features may introduce a visual character that is slightly inconsistent with the character of the unit, which may have minor to medium negative impacts on the unit's features, elements, or key qualities, but the unit's features, elements, or key qualities have low susceptibility or value. VIA: The visibility of the Project would introduce a small but noticeable to medium level of change to the view's character; have a low to medium level of visual prominence that attracts but may or may not hold the viewer's attention; and have a small to medium impact on the viewer's experience. The viewer receptor sensitivity/susceptibility/value is low. If the value, susceptibility, and viewer concern for change is medium or high, the nature of the sensitivity is evaluated to determine if elevating the impact to the next level is justified. For instance, a KOP with a low magnitude of change but a high level of viewer concern (combination of susceptibility/value) may justify adjusting to a moderate level of impact.
Moderate	Adverse	SLIA: The Project would introduce features that would have medium to large levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. The Project would introduce a visual character that is inconsistent with the character of the unit, which may have a moderate negative impact on the unit's features, elements, or key qualities. In areas affected by large magnitudes of change, the unit's features, elements, or key qualities have low susceptibility or value. VIA: The visibility of the Project would introduce a moderate to large level of change to the view's character; may have moderate to large levels of visual prominence that attracts and holds but may or may not dominate the viewer's attention; and has a moderate impact on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to low. Moderate impacts are typically associated with medium viewer receptor sensitivity (combination of susceptibility/value) in areas where the view's character has medium levels of change, or low viewer receptor sensitivity (combination of susceptibility/value) in areas where the view's character has large changes to the character. If the value, susceptibility, and viewer concern for change is high, the nature of the sensitivity is evaluated to determine if elevating the impact to the next level is justified.
Major	Adverse	SLIA: The Project would introduce features that would have dominant levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. The Project would introduce a visual character that is inconsistent with the character of the unit, which may have a major negative impact on the unit's features, elements, or key qualities. The concern for change (combination of susceptibility/value) to the character unit is high. VIA: The visibility of the Project would introduce a major level of character change to the view; attract, hold, and dominate the viewer's attention; and have a moderate to major impact on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to high. If the magnitude of change to the view's character is medium but the susceptibility or value at the KOP is high, the nature of the sensitivity is evaluated to determine if elevating the impact to major is justified. If the sensitivity (combination of susceptibility/value) at the KOP is low in an area where the magnitude of change is large, the nature of the sensitivity is evaluated to determine if lowering the impact to moderate is justified.

KOP = key observation point; SLIA = Seascape and Landscape Impact Assessment; VIA = Visual Impact Assessment

3.16.2.1 Impacts of Alternative A – No Action Alternative on Scenic and Visual Resources

When analyzing the impacts of Alternative A on scenic and visual resources, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the existing conditions for scenic and visual resources (Table G.1 13 in Appendix G, Impact-Producing Factor Tables and Assessment of Resources with Minor [or Lower] Impacts). The cumulative impacts of Alternative A considered the impacts of Alternative A in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix E, Planned Activities Scenario.

Under Alternative A, existing conditions for scenic and visual resources described in Section 3.16.1 would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on scenic and visual resources include other offshore wind projects that could affect the same geographic analysis area for seascape, landscape, and visual resources may be proposed. Users/viewers would continue to pursue locations and activities that rely on the area's coastal and ocean environment scenic qualities.

The discussion of Impacts on scenic and visual resources for Alternative A assumes ideal viewing conditions, including clear skies and an absence of obstructions. Actual views and impacts would depend on a variety of factors, including the character of existing daytime and nighttime visual conditions (i.e., whether existing light sources exist near a viewer or within a seascape or landscape) viewer distance and angle of view, and atmospheric conditions and environmental factors such as haze, sun angle, time of day, cloud cover, fog, sea spray, and wave action. The applicant's simulations of other offshore wind projects in the RI/MA Lease Areas are provided in Appendix I.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on scenic and visual resources include ongoing construction of Vineyard Wind 1 in OCS-A 0501 and the South Fork Wind Project in OCS-A 0517. Construction of Vineyard Wind 1 and South Fork Wind Project, along with planned offshore wind activities, would affect scenic and visual resources through the primary IPFs described below.

Cumulative Impacts

Lighting: Future onshore components of offshore wind projects that could generate visual impacts include substations, operations facilities, and port upgrades. While the specific locations and design of these components have not been determined for all projects under Alternative A, these components could introduce additional lighting into the characteristic nighttime visual environment. Most onshore development for offshore wind projects would occur in areas of existing urbanized or industrial development where similar infrastructure and development exist. Therefore, additional nighttime lighting sources associated with infrastructure to support other offshore wind projects would be an incremental change over time and would have long-term impacts on the viewer's nighttime visual experience and nighttime seascape, open ocean, and landscape character, depending on the final location of infrastructure locations in relation to existing nighttime light sources.

Construction, operations, and decommissioning of future offshore wind projects would increase the amount of offshore light from vessels, area lighting, and the use of aircraft and vessel hazard/warning lighting on WTGs and ESPs during operations. Up to 903 WTGs would be added within the geographic analysis area. Of that total, 883 WTGs could be within 46 miles of onshore viewers in Martha's Vineyard and Nantucket (the theoretical limit for visibility).

Construction lighting would be most noticeable if construction activities occur at night. As shown in Appendix E, up to ten offshore wind projects could be constructed from 2022 through 2030 (with up to six projects other than the proposed Project simultaneously under construction in 2025). These projects would all require nighttime onshore and offshore construction lighting, as well as nighttime navigation and aviation hazard lighting during operations. Lighting associated with night construction and decommissioning of future projects would be localized and temporary, lasting only during nighttime construction. Depending on quantity, intensity, and location, construction light sources could be visible from unobstructed sensitive onshore and offshore viewing locations based on viewer distance. Sources of light would be limited to individual WTG or ESP sites under construction rather than the entire RI/MA Lease Areas.

Aircraft and vessel hazard lighting systems would be in use for the entire operations stage of each future offshore wind project, resulting in long-term impacts. The intensity of these impacts would be relatively low, as the lighting would consist of small intermittent flashing lights at a significant distance from the resources.

FAA hazard lighting systems would be used for the duration of operations for each ongoing and planned offshore wind project. This lighting would include synchronized flashing strobe lights affixed with a minimum of three red flashing lights at the mid-section of each tower and two at the top of each WTG nacelle. Field observations of FAA hazard lighting for the Block Island Wind Farm off the coast of Rhode Island were conducted in May 2019 (HDR 2019b). These observations, which occurred under clear sky conditions in open water, demonstrated that FAA hazard lighting (mounted at the nacelle top, approximately 328 feet AMSL) was visible up to 26.8 miles from the viewer (HDR 2019b). FAA hazard lighting for Alternative A would be mounted substantially higher (up to 725 feet MLLW) and would thus be visible from greater distances, although the contrast of this light would likely diminish at distances greater than 30 miles in all but ideal viewing conditions. This lighting would have long-term impacts.

Permanent aviation and vessel warning lighting would be required on all WTGs and ESPs built by future offshore wind projects. Up to 692 WTGs from other offshore wind projects would be within the geographic analysis area and close enough for the nacelle-top aviation warning lights to be visible from Martha’s Vineyard or Nantucket. Navigation and aviation lighting would add a permanent developed-industrial visual element to views that were previously characterized by dark, open ocean. BOEM assumes that FAA hazard lighting for offshore wind projects in the RI/MA Lease Areas would use ADLS. ADLS would only activate FAA hazard lighting when aircraft enter a predefined airspace; studies for the proposed Project assumed a horizontal buffer of 3 nautical miles (4.1 miles) and a vertical buffer of 3,500 feet from any WTG (COP Appendix III-K; Epsilon 2022a). Under these parameters, ADLS would be activated for the proposed Project less than 13 minutes per year, substantially less than 0.1 percent of annual nighttime conditions (COP Appendix III-K; Epsilon 2022a). BOEM assumes that the use of ADLS for other wind energy projects would similarly limit the duration of WTG aviation warning lighting use throughout the RI/MA Lease Areas.

Lighting impacts would be most pronounced for open ocean, as well as seascapes and landscapes that can be currently characterized as undeveloped, where lighting from infrastructure and activities is not dominant or perceivable by the casual observer. Impacts on visually sensitive resources and seascapes would be short term during construction and long term during operations. Impacts during decommissioning would be similar to those described for construction, but all lighting impacts would cease as offshore wind project components are deactivated and removed.

Port utilization: Future offshore wind projects would support planned expansions and modifications at ports in the geographic analysis area (Section G.2.7, Land Use and Coastal Infrastructure). Improvements at these ports are expected to have similar visual characteristics as existing port facilities. As a result, these additional upgrades would not meaningfully change existing visual conditions at and near ports.

Presence of structures: Future offshore wind projects would add 903 WTGs and associated onshore substations to the landscape (Table E-1 in Appendix E). Of that total, 883 WTGs could be within 46 miles of onshore viewers in Martha's Vineyard and Nantucket (the limit for seaward views, as discussed in Section 3.16.1.2). WTGs visible from onshore locations would create long-term visual impacts. Structures associated with offshore construction activity from multiple projects could be visible simultaneously from some locations, depending on viewing conditions, although construction vessels and equipment would move throughout construction. The applicant's panoramic simulations in Attachment I-2 of Appendix I include views of the full array of WTGs in the RI/MA Lease Areas as viewed from KOPs 1, 3, 4, 5, 8, and 21 (Table 3.16-7). The magnitude of these impacts on viewers and seascape, open ocean, and landscape character would be related to the degree of the perceivable contrast, dominance, and scale of WTGs along the horizontal plane of the horizon, which depend on the viewer's proximity and orientation to the projects. Impacts would either increase or decrease as natural lighting angles and atmospheric conditions change throughout the day, and impacts would generally decrease with viewing distance (Section 3.16.3). The highest potential impacts would occur where seascape and open ocean views are present, such as in the open ocean, ocean beach, coastal bluffs, and shoreline residential units. The lowest impacts would occur for landscape character units with limited views of other offshore wind projects, such as inland forest areas.

Traffic: Future offshore wind project construction, decommissioning, and, to a lesser extent, operations, would generate increased vessel traffic that could add additional visual contrast for views within the geographic analysis area. The impacts would occur primarily during construction, along routes between ports and the future offshore wind construction areas. Some vessels (e.g., jack-up vessels) used for offshore wind project construction and decommissioning would differ in character from vessels normally present in the RI/MA Lease Areas; however, such vessels would be temporary features in any seaward view and would only be present during construction. Other vessels associated with offshore wind activity would be similar in appearance (except when viewed from the water at close range) to vessels already present in the RI/MA Lease Areas.

Conclusions

Impacts of Alternative A. Under Alternative A, the proposed Project would not be built. However, seascape, landscape, and visual resources would continue to be affected by regional commercial, industrial, and recreational activities including future offshore wind projects. While the proposed Project would not be built under Alternative A, ongoing activities would continue to shape onshore features, character, and viewer experience, and would therefore have continuing short- and long-term impacts on seascape, landscape, and visual resources.

The primary source of impacts from ongoing activities include the introduction of intrusive visual elements such as communication towers and new residential, commercial, or industrial development on land. Impacts from these activities could range from **negligible** to **major** depending on the orientation from the resource, what seascape, open ocean, or landscape unit is being impacted, and the type of installation generating the visual impact. Most impacts on scenic and visual resources from ongoing activities would be concentrated in the open ocean, ocean beach, coastal bluffs, and shoreline residential units.

Cumulative Impacts of Alternative A. In addition to ongoing activities, planned activities would result in **minor** to **major** impacts on scenic and visual resources, due to the addition of up to 883 WTGs (excluding the proposed Project) within 40 nautical miles (46 miles) of Martha's Vineyard and Nantucket by 2030 within seaward views, where few, if any, such structures currently exist. Impacts would differ throughout the seascape, open ocean, and landscape units, with the highest potential impacts occurring for open ocean and seascapes and landscapes with open ocean views, commonly found in the ocean beach, coastal bluffs, and shoreline residential units. Units located inland, such as forest and residential units away from the shoreline, would have the lowest impacts. Considering all the IPFs together, ongoing and planned activities in the geographic analysis area would result in **major** cumulative impacts. In clear viewing conditions, WTGs constructed in the RI/MA Lease Areas would be noticeable if not dominant in most south-facing seaward views in the geographic area. More important, the WTGs would introduce a visual character that is inconsistent with the character of seascape and open ocean units that have high levels of sensitivity.

3.16.2.2 Relevant Design Parameters, Potential Variances in Impacts, and Impact Level Definitions

The following proposed Project design parameters (Appendix C, Project Design Envelope and Maximum-Case Scenario) would influence the magnitude of the impacts on seascape, landscape, and visual resources:

- Use of WTGs other than the maximum height WTGs included in the PDE would reduce visual impacts by reducing the area of theoretical visibility, as well as the scale of WTGs visible from land.
- Use of the aboveground installation option for the Phase 1 OECR Centerville River crossing using a pipe utility bridge in the Town of Barnstable would increase visual impacts (COP Section 3.3.1.10, Volume I; Epsilon 2022a).

3.16.2.3 Impacts of Alternative B – Proposed Action on Scenic and Visual Resources

This section identifies the potential impacts of Alternative B on seascape character, open ocean character, landscape character, and viewer experience in the geographic analysis area. Viewers or visual receptors within Alternative B’s zone of theoretical visibility include:

- Residents living in coastal communities or individual residences;
- Tourists visiting, staying in, or traveling through the area;
- Recreational users of the seascape, including those using ocean beaches and tidal areas;
- Recreational boaters and other users of the open ocean;
- Recreational users of the landscape, including those using golf courses, trails, and paths;
- Tourists, workers, visitors, or local people using transport routes;
- People working in the countryside, commerce, or dwellings; and
- People working in the marine environment, such as those on fishing vessels and crews of ships.

As stated for Alternative A, the discussion of impacts on scenic and visual resources for Alternative B assumes ideal viewing conditions, including clear skies and an absence of obstructions. Actual views and impacts would depend on a variety of factors, including the character of existing daytime and nighttime visual conditions (i.e., whether existing light sources exist near a viewer or within a seascape, open ocean, or landscape) viewer distance and angle of view, and atmospheric conditions and environmental factors such as haze, sun angle, time of day, cloud cover, fog, sea spray, and wave action.

Impacts of Phase 1

Phase 1 would affect scenic and visual resources through the following primary IPFs during construction, operations, and decommissioning.

Lighting: Phase 1 would require nighttime lighting for construction vessels traveling and working within the RI/MA Lease Areas, as well as the incremental addition of hazard lighting systems at each WTG and

ESP during a 2-year offshore construction period. This lighting could be visible and could impact a viewer's nighttime visual experience (from shore or at sea) and could also impact the nighttime seascape character. The VIA (COP Appendix III-H.a; Epsilon 2022a) determined that nighttime lighting could affect residents and tourists in beachfront settings where they currently experience dark skies. Most year-round and vacation homes within the geographic analysis area are located inland, where topography, intervening vegetation and structures provide substantial or complete screening of the ocean; however, properties with unobstructed southern views, such as those along southern coastlines or in elevated areas, could view offshore lighting from Phase 1 (including direct views of lights and impacts such as glare or refraction off of clouds and the water). Such lighting would be more than 20 miles from the closest viewers but could still be noticeable due to the prevailing dark-sky conditions.

Light from onshore construction activities could temporarily affect viewers if they are near the landing site, OECR, and proposed onshore facilities. The applicant would install evergreen plantings between the proposed substation at 8 Shootflying Hill Road and adjacent residential properties to the west (COP Appendix III-H.a; Epsilon 2022a), although these plantings may not fully mature during the construction period. However, there are no nighttime visually sensitive areas (public parks, beaches, recreational facilities, and areas of high public use) near the landing site, where nighttime construction could occur and would be limited due to the existing developed character of most of the Phase 1 OECR. Based on viewer location and perspective in relation to existing onshore light sources and the duration of effects, light from Phase 1 construction would have short-term, localized, and **minor** impacts on a viewer's offshore nighttime visual experience and nighttime seascape, open ocean, or landscape character. Light from Phase 1 would have short-term and **negligible** to **minor** impacts on onshore nighttime visual experience and nighttime character.

During operations, Phase 1 would contribute to nighttime lighting due to required FAA hazard lighting of up to 62 WTGs and 1 or 2 ESPs. USCG-required navigation warning lights would be mounted on the foundation on each WTG and ESP. The lighting is designed to be visible to at least 5 nautical miles (5.8 miles) during low visibility conditions and would be visible from further away under clear conditions (COP Appendix III-H.a; Epsilon 2022a). This lighting could be visible to mariners at sea but would not be visible from coastal vantage points due to distance, the curvature of the earth, and the low mounting height of the lights (i.e., no more than 148 feet MLLW, based on the height of the WTG platform) (COP Section 3.2.1, Volume I; Epsilon 2022a). Furthermore, the applicant's commitment to use ADLS would reduce impacts from FAA hazard lighting. During times when ADLS activates the Phase 1 FAA hazard lighting, this lighting would add a developed-industrial visual element to views that were previously characterized by dark, open ocean. Use of ADLS would result in shorter duration night sky impacts (predicted to be less than 13 minutes per year, or less than 0.1 percent of all annual nighttime conditions) on the viewer's visual experience and characteristic seascape.

Lights on WTG and ESP platforms used for periodic maintenance could potentially be visible from beaches and adjoining areas at night, either directly (in locations that have a direct line of sight to the WTG or ESP being maintained) or indirectly through reflection of light from the ocean surface or clouds. When illuminated, maintenance lighting or FAA hazard lighting would have **major** impacts on nighttime visual resources due to the presence of artificial lighting in an otherwise unlit area of the ocean. When not illuminated, the FAA hazard lighting would have a **negligible** impact, if any.

Nighttime security lighting for the proposed substation, while in use, could result in glare for nearby residential properties. Evergreen plantings installed during construction would shield residential properties west of the substation site from some of this lighting (COP Appendix III-H.a; Epsilon 2022a), and mature vegetation throughout the area would screen most views of the lighting. BOEM is evaluating the following mitigation and monitoring measure to address impacts on scenic and visual resources, as described in detail in Table H-2 of Appendix H, Mitigation and Monitoring. The Final EIS will list the mitigation and monitoring measures that BOEM would require as a condition of COP approval.:

- Reduce lighting at onshore facilities, including, but not limited to, the use of the minimum number and intensity of lights necessary for safe nighttime operations and the use of full cut-off fixtures to prevent light from illuminating unnecessary areas.

The Phase 1 expansion of the West Barnstable Substation would not be adjacent to developed residential lots but would be separated from the existing homes by an undeveloped, wooded lot and the existing substation site. Additional substation lighting impacts would be minimal due to the distance from the residential lots to the new substation. BOEM would also require a lighting plan as listed in Appendix H, to ensure that lighting is shielded and directed to eliminate glare and spillover onto adjacent properties. Accordingly, with implementation of mitigation (Appendix H), security lighting for the new substation and expansion of the West Barnstable Substation would have a long-term, continuous, and **negligible** to **minor** impact on a viewer’s nighttime visual experience and nighttime seascape, open ocean, and landscape character.

Light associated with Phase 1 during decommissioning would have the same impacts as light for Phase 1 construction, with localized, short-term, and **negligible** impacts on scenic and visual resources.

Port utilization: Phase 1 staging and construction support would use several ports (Section G.2.7) and generate an average of 7 and a peak of 15 vessel round trips daily between ports and offshore construction work areas. Some ports potentially used for Phase 1 construction would be upgraded to support the offshore wind industry as a whole; however, Phase 1 would not include upgrades at specific ports. The use of and upgrades or expansions at these ports would continue the existing land use and visual character in these locations and would not introduce any contrasting visual elements. Construction of Phase 1 would, therefore, have a short-term and **negligible** impact on scenic and visual resources.

The applicant anticipates using Bridgeport Harbor as the operations base and Vineyard Haven Harbor for crew transfer and support vessels during Phase 1 operations (COP Section 7.8.2.1, Volume III; Epsilon 2022a). Port utilization during operations would result in continuation of existing activities and no noticeable change in the visual character of port facilities. As a result, Phase 1 operations would have long-term, continuous, and **negligible** impacts on scenic and visual resources due to port utilization.

Decommissioning may result in increased use of port facilities, although upgrades discussed for offshore wind construction would already have occurred. Therefore, the impacts of port utilization for decommissioning of Phase 1 would have short-term and **negligible** impacts on scenic and visual resources.

Presence of structures: Up to 63 Phase 1 structures (including up to 62 WTGs and 1 or 2 ESPs) would be installed in the SWDA. During construction, offshore and onshore observers would view the upper portions of tall equipment such as mobile cranes and vessels, as well as WTGs, as they are erected. Construction vessels and equipment would move from each WTG and ESP location as the 2-year offshore construction period (and specifically the approximately 1 year required to construct ESPs and WTGs) progresses and, thus, would not be long-term fixtures. As a result, the presence of structures during Phase 1 construction would have short-term, localized, and **minor** impacts on the viewer’s offshore visual experience and seascape character.

Phase 1 substation construction at 8 Shootflying Hill Road would include the removal of an existing motel and the installation of the proposed improvements within a larger footprint, as well as a potential expansion of the existing West Barnstable Substation. The applicant would install evergreen plantings between the proposed substation at 8 Shootflying Hill Road and adjacent residential properties to the west (COP Appendix III-H.a; Epsilon 2022a), although these plantings might not be fully mature during the construction period. Vegetation clearing and taller equipment (e.g., cranes) would be visible from certain vantage points during construction of the onshore facilities during the 2-year onshore construction period. During this period, there would be an immediate change in landscape character and the user's visual experience in the immediate foreground of the substation because of the removal of the motel. Due to low viewer sensitivity, low scenic value, and low landscape susceptibility to change, the impacts of the presence of structures on onshore visual experience and landscape character during construction of the Phase 1 substation would be short-term, localized, and **negligible**.

The offshore components of Phase 1 would be most visible from coastal locations on Martha's Vineyard and Nantucket. Visual simulations for the proposed Project (Section 3.16.1.3) demonstrate that Phase 1 and Phase 2 WTGs and ESPs (separate simulations were not prepared for Phase 1 and Phase 2) would be partially visible on the horizon from shore where generally unobstructed views are commonly found (COP Appendix III-H.a; Epsilon 2022a). The distance between the viewer and the WTGs, along with the curvature of the earth, affect how much of the WTG is visible from viewer locations and influence its visible scale and dominance. The impacts of sun lighting, shade, and shadows would cause backlit contrasts and higher impacts for onshore and offshore views from northeast, north, and northwest of the proposed Project. The color contrast would vary due to sun angles, cloud cover, and atmospheric clarity, shifting from WTGs painted non-reflective white or light gray (Chapter 2, Alternatives) against a blue or gray backdrop to dark gray WTGs against a light gray backdrop. Observed from 21 miles away (i.e., the closest viewpoint on land), the width of a proposed Project WTG base would be equivalent to the width of a pencil viewed from 113 feet, while the WTG blade width would be equivalent to the width of a drinking straw 91 feet away (COP Appendix III-H.a; Epsilon 2022a). Phase 1 and Phase 2 together would occupy approximately 10 to 20 percent of the 180-degree horizon line visible from any single location on Martha's Vineyard and Nantucket (Appendix I). Motion of the WTG blades, which cannot be shown in photo simulations, would draw attention, increasing visibility of the WTGs.

As shown in the representative visual simulations in the COP (Appendix III-H.a; Epsilon 2022a) proposed Project WTGs would appear low on the horizon because of their distance from the KOPs (the nearest WTG would be a minimum of 22.8 miles from KOP 2 and a maximum of 30.9 miles from KOP 8), as well as the influence of the curvature of the earth, which affects the portion of the WTG structure visible above the horizon (e.g., tower, nacelle, and blades; nacelle and blades; or just blades). The WTGs would be more visually apparent as viewed from the north (e.g., KOPs 2, 3, and 4) primarily due to viewing distance. The scale of the WTGs and ESPs would become less perceivable in the seascape as the distance from viewer locations is increased. As stated previously, atmospheric and environmental factors would also influence visibility and perceivability from sensitive viewing locations. While Phase 1 would include up to 62 the 130 WTGs considered in the maximum-case scenario for scenic and visual resources (Appendix C), viewers would perceive Phase 1 WTGs as being "in front of" (i.e., closer to and potentially blocking) Phase 2 WTGs in most cases and would generate the bulk of the proposed Project's scenic and visual impacts under this IPF. The visual sensitivity of seascape, open ocean, and landscape units in the geographic analysis area is discussed in Section 3.16.1. The magnitude and overall impact of Alternative B on seascape, open ocean, and landscape units is summarized in Section 3.16.4.3. The impacts of Alternative B would only occur in locations where the proposed Project is visible. Thus, while some of the affected seascape, open ocean, and landscape units have high susceptibility, value, and sensitivity, Phase 1 would only affect a portion of most of these units. Considering these factors, as well as the applicant's simulations (COP Appendix III-H.a; Epsilon 2022a), the presence of structures during Phase 1 operations would cause long-term and **minor** to **moderate** impacts on seascape/landscape resources (seascape, open ocean, and landscape units) and **minor** to **major** impacts on the users' visual experience for the life of Phase 1.

KOPs 23 through 25 (Table 3.16-7) provide views of the Phase 1 substation site. Attachment I-2 in Appendix I includes the applicant's single-frame simulations of these sites, which include the mature evergreen plantings installed along the substation property's western edge as part of the proposed Project (COP Appendix III-H.a; Epsilon 2022a). The substation would differ substantially in visual character from the existing hotel (KOP 23) and the commercial structures and Park and Ride lot on the north side of U.S. Route 6 (KOP 25) and would introduce new industrial-utility structures into the landscape. These land uses have low susceptibility to change in the landscape and low scenic value. At KOP 24, the substation would differ in visual character from the trees that it would replace at the edge of ROW #343 but would generally be similar in character (especially color, texture, and form) to the transmission towers visible within ROW #343.

The Phase 1 substation would be most noticeable to the residents living along Shootflying Hill Road and those traveling to their homes on adjacent streets. These views would occur on the north and west side of the proposed site. The evergreen buffer on the western and northern boundaries of the substation site—to be installed by the applicant as part of the proposed Project—would provide visual screening for existing residences and Shootflying Hill Road. Land abutting 6 Shootflying Hill Road is undeveloped and wooded. Because the southern boundary of the substation site extends into ROW #343, no vegetated screening would be possible in that location; however, the ROW already contains aboveground structures and utility lines that are part of the existing landscape and visual character of the area. Where visible at foreground distances (i.e., less than 0.5 mile away), the substation would introduce new industrial-utility structures into the landscape but would not be out of scale or character with nearby development such as the existing transmission equipment in ROW #343, the U.S. Route 6 corridor or the nearby Park and Ride and rest area. Due to low viewer sensitivity, low scenic value, and low landscape susceptibility to change, the impacts of the presence of structures on onshore visual experience and landscape character during construction of the Phase 1 substation would be short term, localized, and **negligible**.

If the applicant installs the Phase 1 OECR crossing of the Centerville River using a pipe utility bridge, the resulting structure would add an industrial structure immediately adjacent to the existing road bridge that carries Craigville Beach Road across the river. This structure would be visible from residences near the bridge and by other user groups traveling on Craigville Beach Road and in the Centerville River; however, the extent and duration of views would be limited to the immediate vicinity of the east side of the bridge. This option is not the applicant's preferred installation method (COP Section 3.3.1.10, Volume I; Epsilon 2022a). For these reasons, operations of the Phase 1 substation would result in long-term and **negligible** impacts on the onshore viewer's visual experience and landscape character at all identified KOPs, except for localized and **minor** impacts if the aboveground Centerville River crossing is installed.

Visual impacts from Phase 1 decommissioning would be similar to construction activities. The Phase 1 substation structures may remain, subject to discussions with the Town of Barnstable (COP Appendix III-H.a; Epsilon 2022a). As a result, impacts from the presence of structures on onshore visual experience and landscape character during Phase 1 decommissioning would be short term or long term (depending on whether the substation remains in place), localized, and **negligible**.

Traffic: Phase 1 construction would contribute to increased vessel traffic that could add additional visual contrast at identified views within the geographic analysis area, similar to the impacts described for Alternative A. Phase 1 would result in short-term, variable, and **negligible** impacts on offshore visual experience and seascape character.

Phase 1 operations would contribute to increased vessel traffic. This vessel traffic would be less than, but otherwise similar to, the traffic described for the construction phase. As a result, vessel operations from

Phase 1 would result in short-term, variable, and **negligible** impacts on offshore visual experience and open ocean and seascape character.

The impacts of vessel traffic during decommissioning would be the same as that described for construction.

Impacts of Phase 2

The impacts of Phase 2 construction, operations, and decommissioning would be similar to or the same as those described for Phase 1. While Phase 2 would involve the construction, operations, and decommissioning of more WTGs (88 versus 62) and ESPs (up to three versus up to two), the incremental differences in activity between Phase 2 and Phase 1 would not change any of the impact magnitudes described for Phase 1 construction.

If the applicant includes the SCV as part of the final proposed Project design, construction of the SCV OECC would result in the presence of structures (i.e., temporarily stationary vessels and onshore structures in Bristol County, Massachusetts) and vessel lights in a different location than the proposed Phase 2 OECC. The impacts of this activity on seascape, landscape, and visual resources would be similar to those described for Phase 1 and Phase 2. Implementation of the SCV would impact onshore seascape, landscape, and visual resources in Bristol County. Those impacts will be evaluated in a supplemental NEPA analysis once the onshore route is identified.

Cumulative Impacts

The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities described in Table G.1-13 in Appendix G would contribute to impacts on scenic and visual resources through the primary IPFs of lighting and the presence of structures. Onshore construction associated with other offshore wind projects is not expected to occur in the same area as Alternative B onshore construction and, thus, would not generate cumulative impacts. Construction and operational lighting from other offshore wind projects (i.e., navigation lights and aviation hazard lights) would often be visible at the same time as lighting from Alternative B. As stated in Section 3.16.2.1, BOEM assumes that all offshore wind projects in the RI/MA Lease Areas would use ADLS, which would greatly limit the frequency and duration of aviation hazard lighting use. During the daytime, WTGs from Phase 1 would be perceptible but indistinguishable from the WTGs of other projects. Proposed Project WTGs would generally be "behind" the WTGs from other projects and would, thus, contribute only incrementally to the overall seascape, landscape, and visual impacts.

Based on these considerations, ongoing and planned activities in the geographic analysis area, including Alternative B and other offshore wind projects combined with ongoing activities, would have long-term and **minor** to **major** impacts on visual experience and seascape, open ocean, and landscape character. **Moderate** impacts would be concentrated in open ocean and seascape and landscape units near the shore, while **minor** impacts would be concentrated in units located further inland. Short-term and m**ajor** impacts would occur when aviation hazard lights are illuminated. Onshore facilities would have long-term, localized, and **negligible** impacts.

Conclusions

Impacts of Alternative B. Based on the IPFs described for Alternative B, Table 3.16-9 summarizes the SLIA magnitude ratings for each seascape, open ocean, and landscape unit within the geographic analysis area. These ratings only apply to locations within units that have views of the proposed Project and other offshore wind projects. Areas with no views of a WTG would experience no seascape/landscape impacts.

Table 3.16-10 describes the VIA impact ratings for each KOP for which simulations (single frame or panoramic) were prepared.

Construction, operations, and decommissioning would introduce visible vessels, structures, and hazard lighting to the geographic analysis areas. The most substantial seascape/landscape and visual impacts would occur due to the presence of structures, specifically the proposed Project's WTGs and onshore substation. As described for the IPFs above, the impacts resulting from Alternative B would range from short term to long term and from **negligible** to **major**, depending on the seascape, open ocean, or landscape unit affected and the exact location of a viewer. Appendix I provides a more detailed description of this range of impacts. Alternative B would have long-term and **minor** overall impacts on seascape/landscape resources and long-term and **minor** impacts on viewer experience. Overall, the impacts of Alternative B on scenic and visual resources would be long term and **minor**, primarily due to the impacts on open ocean and seascape units (Table 3.16-9). In clear viewing conditions, the proposed Project's WTGs would be noticeable (although not dominant) for most south-facing seaward views in the geographic area. More important, the WTGs would introduce a visual character that is inconsistent with the character of the affected seascape and open ocean units, all of which have high levels of sensitivity.

Cumulative Impacts of Alternative B. The incremental impacts of individual IPFs from ongoing and planned activities would range from **negligible** to **major**. Alternative B when combined with ongoing and planned activities would have **major** cumulative impacts on the viewer's visual experience and **moderate** impacts on the seascape, open ocean, and landscape character. This determination reflects the cumulative **moderate** impacts of other offshore wind projects and the **minor** impacts of the proposed Project alone. Proposed Project WTGs would be perceptible but indistinguishable from the WTGs of other projects. Proposed Project WTGs would generally be "behind" the WTGs from other projects and would, thus, contribute incrementally to the overall seascape, landscape, and visual impacts.

Table 3.16-9: Seascape and Landscape Impacts from Presence of Structures

	Seascape and Landscape Units Impacted	
Impact Level[a]	**Proposed Project**	**Proposed Project and Other Offshore Wind Projects**
Negligible	Forest	Forest
Minor	Salt Pond/Tidal Marsh, Coastal Scrub Brush, Shoreline Residential, Village/Town Center, Rural Residential, Suburban Residential, Agricultural/Open Field	Village/Town Center, Rural Residential, Suburban Residential, Agricultural/Open Field
Moderate	Coastal Dunes	Coastal Dunes, Salt Pond/Tidal Marsh, Shoreline Residential, Coastal Scrub Brush
Major	Ocean Beach, Coastal Bluffs, Open Ocean	Ocean Beach, Coastal Bluffs, Open Ocean, Coastal Dunes

[a] This is applicable to portions of each seascape or landscape unit where views of the proposed Project and other offshore wind projects would be visible. No impacts would occur where offshore wind projects are not visible.

Table 3.16-10: Visual Impacts from Presence of Structures

KOP	Impact Magnitude Proposed Project	 Proposed Project and Other Offshore Wind Projects
1. Aquinnah Cultural Center	Minor	Major
2. Long Point Beach	Minor	Moderate
3. South Beach	Minor	Major
4. Wasque Reservation	Minor	Major
5. Madaket Beach	Minor	Major
6. Miacomet Beach and Pond	Minor	Moderate
7. Bartlett's Farm	Minor	Minor
8. Tom Nevers Field	Minor	Moderate
21. Peaked Hill Reservation	Minor	Major
23. Shootflying Hill Road (Existing Hotel)	Moderate	NA[a]
24. Shootflying Hill Road (Transmission Corridor)	Minor	NA[a]
25. Exit 6 Park and Ride/Highway Rest Area	Minor	NA[a]

KOP = key observation point; NA = not applicable

[a] No other offshore wind projects would interconnect at the Phase 1 substation; therefore, there is no impact rating for the proposed Project in combination with other offshore wind projects.

3.16.2.4 Impacts of Alternative C – Habitat Impact Minimization Alternative on Scenic and Visual Resources

Alternatives C-1 and C-2 would not affect the number or placement of WTGs or ESPs or the location or character of substation facilities for the proposed Project compared to Alternative B. Therefore, the impacts of Alternatives C-1 and C-2 on scenic and visual resources would be the same as those for Alternative B.

U.S. Department of the Interior (DOI)

The DOI protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors the Nation’s trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

Bureau of Ocean Energy Management (BOEM)

BOEM’s mission is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.

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